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OF

BRITISH GUIANA.

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EDITED BY

ALLEYNE LEECHMAN, M.A. (Oxon), F.L.S., F.C.S., F.E.S.

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NOTICE.

The Scientific and Technical Department of The Imperial Institute.

His Excellency the Governor desires to call attention to the advantages offered by the Imperial Institute to merchants, planters and others who may wish to have samples submitted to scientific experts for opinion as to their commercial value, etc. The following extracts from a memorandum published by the Authorities of the Imperial Institute will give an idea of the work undertaken and carried on there.

"The Scientific and Technical Department of the Institute has been established to acquire information by special inquiries and by experimental research, technical trials and commercial valuation, regarding new or little known natural or manufactured products of the various colonies and dependencies of the British Empire and of foreign countries, and also regarding known products procurable from new sources, and local products of manufacture which it is desired to export. This work is carried out with a view to the creation of new openings in trade, or the promotion of industrial developments."

2. In an extensive and well-equipped series of research laboratories, a numerous staff of skilled chemists carries out the investigation of the chemical constitution and properties of new dye stuffs, tanning materials, seeds and foodstuffs, oils, gums and resins, fibres, timbers, medicinal plants and products, with a view to their commercial utilization. Whenever necessary, these materials are submitted to special scientific experts, by whom they are made the subject of particular investigation or practical test. Reports are also obtained from technical or trade experts in regard to the probable commercial or industrial value of any such products.

3. The British Guiana Government grants a sum of £150 a year to the Department with a view to the careful investigation and commercial development of the resources of the colony.

The Permanent Exhibition Committee is collecting specimens for examination, and the Imperial Institute, which is in very complete touch with the principal manufacturing and other industries of the United Kingdom, will bring the specimens before manufacturers and others for trial with a view to their commercial development.

It is hoped that this action will do much to help in finding a market for new products and developing the market for those already exploited.

Planters and residents in British Guiana are at liberty to send (through the Secretary to the Permanent Exhibition Committee) specimens of little known or new vegetable or mineral products of the colony for examination at the Imperial Institute, by whom a report will be made through the Government Secretary. Specimens should, if possible, consist of a few pounds of the materials, and must be accompanied by full information, especially respecting the precise locality in which the material is found and the extent of its occurrence.

Attention may also be drawn to the "Bulletin of the Imperial Institute," published quarterly, by Mr. John Murray which contains records of the investigations conducted at the Imperial Institute, and special articles on tropical agriculture and the commercial and industrial uses of vegetable animal and mineral products. Copies of this publication, price 2s. 9d. per number, or 11s. per annum (including postage), may be ordered through "The Argosy" Company, Limited.

Special sample-rooms have been arranged at the Imperial Institute for the information of inquirers in which materials which have been investigated and valued are available for reference.

Important products of the Colony are shown in the British Guiana Court in the Public Galleries of the Imperial Institute

SUBSCRIPTIONS TO "THE JOURNAL."

A number of complaints have been received, particularly from the country districts, that would-be readers of "The Journal" are unable to obtain copies. Our system of distribution has been made as complete as possible, but the demand at many centres has so exceeded the supply that some disappointment has been inevitable. We would point out, however, that by the simple method of

SUBSCRIPTION

all inconvenience can be avoided. The sum of

FOUR PENCE

remitted to

**The Assistant Director of
Science and Agriculture,
Botanic Gardens,
Georgetown,**

will ensure the delivery of one volume (four numbers) of "The Journal," post free, for one year. This method is earnestly commended to all our readers, present and prospective.

Lands and Mines Notice.

NOTICE is hereby given, for general information, that His Excellency the Governor has decided that in future except under special circumstances, no Crown Land will be sold or granted but that such land will only be rented under Leases for terms of Ninety-nine (99) years or under with a right of renewal, if the conditions attached to such Titles have been strictly complied with, for one similar period, subject to a re-assessed rental.

2. The rents so be charged for such land will, *ordinarily*, be as follows:

For any area up to 5 acres, $1 per annum.
For areas over 5 and up to 100 acres at 20 cents per acre per annum.
For areas over 100 and up to 500 acres at 15 cents per acre per annum.
For areas above 500 acres at 10 cents per acre per annum.

These rates will not, however, apply to land which may be leased for the cultivation of Rubber, Limes and other Citrus Fruits, Coconuts, Cacao, Coffee, Sisal or other economic cultivation for which special terms and conditions are fixed.

3. The Crown Lands Notice in the *Official Gazette* of 2nd April, 1910, fixing the rate at which Crown Land will be sold is hereby cancelled and withdrawn.

FRANK FOWLER,
Commissioner of Lands and Mines

Department of Lands and Mines
Georgetown Demerara, 20th December, 1913.

Terms and Conditions on which Crown Lands in British Guiana can be obtained for the Cultivation of Rubber, Limes or other Citrus Fruit, Cacao, Coffee, Fibres, Coconuts, and other Permanent Agricultural Products, under the Crown Lands Ordinance of 1903.

The Governor will in ordinary cases grant leases of areas of land of such acreage as he may think fit for the purpose of cultivating thereon all or any of the following products, viz., rubber, limes or other citrus fruit, cacao, coffee fibres, coconuts and other permanent agricultural products thereon for a term of ninety-nine years subject to the following terms and conditions:—

(*a.*) No rent shall be payable during the first five years of the lease, but the lessee shall pay an annual rent of twenty-five cents an acre from the sixth to the tenth year inclusive, and an annual rent of eighty cents an acre during the remainder of the lease, and in default of payment of such rent on the day on which the same is due, the lessee shall in addition pay interest thereon at the rate of six per centum per annum for each day of such default.

(*b.*) The lessee shall each year plant not less than one twenty-fifth part of the land leased until he has so planted not less than the seven twenty-fifths part of the said land and shall maintain such cultivation in good order to the satisfaction of the Governor-in-Council or of such Officer as may be from time to time deputed by the Governor-in-Council to inspect the cultivation, the minimum number of trees to be planted to the acre as above provided shall in every case be that stated in the schedule of requirements as to cultivation hereto appended, or such lesser number as the Governor-in-Council may having regard to the nature of the land comprised in the lease or for other reason, determine.

(*c.*) During the continuance of the lease the lessee shall pay the sum of two cents a pound for all rubber, balata, or other substances of a like nature obtained by him from indigenous trees on the land.

(*d.*) In clearing the said land for cultivation no rubber or balata tree shall be destroyed without the permission in writing of the Commissioner of Lands and Mines.

(*e.*) The lessee shall not transfer his interest in the land leased, or any part thereof, save with the permission of the Governor, but such permission shall not be unreasonably withheld.

(*f.*) If the lessee employs Aboriginal Indians, he shall keep on the tract a book which shall be open at all times to the inspection of the Protector of Indians, the Sub-Protectors of Indians, the Magistrate of the district, and of any Officer of the Department of Lands and Mines, Commissary of Taxation, or Officer of the Police Force, and in which shall be regularly entered the names and tribe of every such Aboriginal Indians, the rate of wages allowed, and the amount paid; and all such wages shall be paid in money except with the sanction in writing (which may either be special or general) of the Protector of Indians and shall be paid (as the labourer may desire) either weekly or at the expiration of his contract, or part weekly and the remainder at the expiration of his contract.

(*g.*) The lessee shall not give or deliver to any labourer any spirituous liquor as an equivalent for, or in payment of, wages or for any work or labour done or performed for him by such labourer.

(*h.*) The lessee shall place and keep on the façade of the land leased on or near to each boundary paal, a board or tablet on which shall be printed in plain legible letters and figures the name of the lessee, the length of the façade, the compass bearings and depth of the sidelines of the land, and the number and date of the lease under which he holds it; and the lessee shall keep such board or tablet with such inscription in good repair during the continuance of the lease, and he shall also keep the boundary lines of the land so far as he has cultivated or beneficially occupied it clear and open at all times to the inspection and reasonable satisfaction of any Officer of the Department of Lands and Mines:

(*i*.) The land leased shall be subject to the right of way across any portion of it to the Crown Lands aback of the said land for the officers and servants of the Crown and Government the Colony and others thereto authorised by the Crown or Government.

(*j*) The lease shall not confer on the holder any right to take or obtain any minerals or mineral oil from any deposit that may exist in or under the land leased and all officers of the Crown or Government and other persons thereto specially authorised by the Government shall, at all times have the right to enter such lands for the purpose of obtaining any minerals or mineral oil therefrom; provided that the lessee shall have the right to compensation for any damage suffered by him in consequence of such entry and the obtaining of any minerals or mineral oil from the said lands.

(*k*.) If the lessee pays the rent reserved and observes and performs all the covenants and conditions contained in the lease, he shall and may peaceably and quietly possess and enjoy the land leased without any interruption by the Crown or any person lawfully or equitably claiming from or under the Crown.

2. If any of the said terms and conditions are not complied with, or the rent is not paid within fifteen days of the same becoming due, the Commissioner shall have the right to re-enter the land leased and take possession of the same, without paying compensation for buildings or machinery erected by the lessee on the said land.

3. If all the terms and conditions of the lease have been complied with, the lessee shall have the right, at any time after the expiration of five years from the date of the lease to give up and surrender any part of the land comprised in the lease not being more than one-half thereof as may be approved of by the Commissioner of Lands and Mines and thereupon the said lease shall cease and determine as to such land so surrendered and given up, but shall remain valid and effectual as to all the land comprised in it not so given up and surrendered, and if the lessee exercises the right thereby given he shall pay the sum of five dollars for each acre of land retained, and shall also pay an annual rent of five cents for each said acre so retained from and after the time when he exercises such right as aforesaid during the remainder of the lease in lieu of the rent reserved in paragraph (*a*) of Clause 1 hereof, but save as aforesaid all the terms and conditions the lease shall remain in full force and effect.

4. The fees payable for obtaining a lease, which must be deposited with the application are as follow:—

	$ c.
Application	5 00
Survey—	
Areas up to 500 acres, per acre ..	30
Each acre above 500 and up to 1,000 ...	20
Each acre above 1,000	10
These charges include labour, cutting lines, etc.	

The lessee may be also required to pay the cost of drawing up, executing and stamping lease in Registrar's Office, say $16.20.

Schedule of Requirements as to Cultivation.

Rubber ...	not less than	40	trees to one acre.
Limes & other citrus fruits	do.	100	do.
Coconuts	do	30	do.
Cacao..	do	120	do.
Coffee	do	150	do
Sisal	do.	300	plants to one acre.
African Oil Palm	do.	30	trees to one acre.

NOTE:—In case of interplanting, such interplanting must be carried out to the satisfaction of the Officer who may from to time be deputed to inspect the land.

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Visual Instruction.

It is impossible not to admire the striking way in which the Americans carry out new ideas. Theatrical their methods may be, but undoubtedly they show originality and enthusiasm. As an instance we may quote the Bureau of Health Exhibit at the Philippine Exposition of 1914. The exhibit was wholly educational in character and consisted of models, photographs, placards and cinematograph pictures The last three of these are familiar enough, although often unaccountably neglected by the British; but the first seems to have been carried to the limit. "Huge models, having true proportion and colouring, were shown of flies, mosquitoes, bed bugs, cockroaches, fleas and disinfecting pumps. These models were also used in the Carnival parade accompanied by signs with appropriate catchy legends and rimes (*Anglicé* 'rhymes'). The disinfecting pumps were shown pursuing the insects." The models of the insects were approximately 6 ft. in length and the pumps about 20 inches in diameter and 7½ ft. in height. The photographs of the display fully bear out these dimensions: and we read without surprise that "The exhibit attracted widespread attention and elicited much favourable comment both in the Carnival parade and in the Exposition." To the civilized eye the 'parade' may possibly have appeared as a mixture of a Masquerade and a travelling Circus: but we can imagine no better way of impressing the unsophisticated but susceptible mind of the native.

Yields of Varieties of Sugar-Cane: Crops of 1913.

By J. B. Harrison, C.M.G., M.A., Director, and C. K. Bancroft, M.A., F.L.S., Assistant Director, of Science and Agriculture.

THE yields of different varieties of sugar-cane cultivated in the colony in 1913 were as follows:—

Reports were received from 26 plantations as to their crops of Bourbon canes; on 25 of them the area under Bourbon exceeded 20 acres. The yields varied from 1.05 ton to 2.28 tons of sugar per acre, the mean yield being 1·70 ton of commercial sugar per acre.

Thirty-three plantations reported results with D 625; each having more than 20 acres of the variety. The lowest return per acre was 1.26 T* and the highest 2.35 T whilst the mean yield was 1.79 T.

Twenty-three plantations supplied returns from D 145; 22 of them having over 20 acres of this variety each. The extreme yields were .85 T. and 2.16 T., whilst the mean yield was 1.67 T.

Twenty-three estates supplied returns for B 208, the extremes being 1.00 and 2.80 T. whilst the mean was 1.70 T. Sixteen of the estates reaped more than 20 acres each of the variety, the extreme yield reported by them being 1.27 T. and and 2.80 T., whilst the mean worked out at 1.70 T.

D 109 was reaped on 16 plantations on areas of more than 20 acres each. The maximum yield recorded was 2.05 T. and the minimum .64 T, the mean of all being 1.53 T.

B 147 was returned from 9 estates, five of which had under cultivation more than 20 acres of it. The mean yield was 1.60 T. on all of the areas, the maximum being 2.66 T. and the minimum .89 T.

Green Transparent was reaped on 6 plantations, each having more than 20 acres of it. The extremes of the yields obtained were 1.50 T. and 2.50 T. whilst the mean was 1.92 T.

* T=tons of commercial sugar per acre.

Two estates returned results from the White Transparent, the mean yield being 1.25 T.

D 4397 was reaped on 5 plantations, only one of which possessed over 20 acres of it. The mean return was 1.65 T. and the extremes of yield 1.00 and 1.86 T.

Diamond 185 was returned from three estates from areas of over 20 acres each. A mean yield of 1.82 T. was obtained, the highest being 2.12 and the lowest 1.59.

The minimum, maximum and mean yields of certain other varieties are shown in the following table :—

Canes.	*No. of Trials.*	*Yields in Tons of Sugar per Acre.* Minimum.	*Maximum.*	*Mean*
D 216	3	1.60	2.49	2.14
D 167	2	1.70	2.50	2.10
D 118	4	1.60	2.22	1.95
D 116	2	1.56	2.25	1.90
D 721	2	1.75	2.00	1.87
D 419	4	1.44	1.99	1.80
D 4399	2	1.71	2.75	1.73
B 376	3	1.57	2.00	1.70
D 117	2	1.43	1.52	1.47
B 3956	3	1.19	1.51	1.30

Single trials only are reported with the following varieties, most of which gave results of some promise :—

Varieties.	*Yield of Sugar : Tons per acre.*
B 3412	3.53
Diamond 581 .	2.80
Java 2 ...	2.35
„ 3	2.32
RP 4	2.30
B 1753	2.27
RP 5	2.24
RP 1	2.22
Java 4	2.20
Diamond 399 ...	2 20
D 216	2.00
B 190	2.00
D 4395	2.00
RP 89	1.96
D 1087	1.95
Java 1'	1.92
D 382	1.91
Sealy	1.88

(C'td.) *Varieties.*	*Yield of Sugar : Tons per acre.*
P 28	1.82
J 100	1.81
D 74	1.80
P 10	1.77
J 247	1.70
B 109	1.65
Badilla ...	1.44

In all fifty-six varieties were reported as being under large scale cultivations and trials in 1913.

The results of the at present more important varieties were recorded from the following areas :—

Varieties.	*Areas.*
D 625	18,495
Bourbon	9,899
B 208	6,904
D 145	4,607
D 109	1,781
Diamond 185	848
Green Transparent	703
B 147	443
D 116	93
White Transparent	87
D 74	67
D 199	65
D 4399	63
B 376	61
D 4397	58
Diamond 399	36
R P 5	22
D 177	20
D 118	17

The following comparisons of the yields of certain varieties in 1911, 1912, and 1913 are of some interest :—

	Yield of Sugar. Tons per acre.		
Varieties.	*1911.*	*1912.*	*1913.*
B 3412	4.12	2 81	3.53
P 6	3.47	1.73	·97
Diamond 382	3.32	1.96	1 91
P 2	3.25	1.42	·74
D 199	2.08	1.15	1.48
D 419	2.07	1.50	1.80
Diamond 399	1.96	1.49	2.20
Diamond 581		2.55	2.80
B 1753		2.27	2.27

The data obtained in 1913 confirm earlier experience that certain new varieties when cultivated on the large scale and over widely distributed areas are capable of giving yields considerably in excess of those of the Bourbon in the condition it has been of late years. The Bourbon, however, in 1913 gave on the whole more satisfactory results than it has done for some seasons.

THE AREAS OF VARIETIES OF SUGAR-CANE FOR THE CROP 1914.

Reports have been received from 37 plantations showing the areas under cultivation in different varieties for the 1914 crops. All of these have areas under D 625 amounting to 31,130 acres, an increase of 5,760 acres on the area under cultivation in the previous year with this seedling variety; 27 plantations have 6,864 acres of B 208; 28 have 5,782 acres of D 145; 21 have 2,164 acres of D 109; 5 plantations have 1,431 acres of Diamond 185; 9 have 1,116 acres of Green Transparent; 9 have 261 acres of B 147; 9 have 169 acres of D 118; 5 have 157 acres of D 116; 2 have 140 acres of Java 100; 2 have 116 acres of D 115; 7 have 95 acres of D 419; 7 have 91 acres of D 4397; 8 have 74 acres of D 4399; 2 have 71 acres of D 74; 4 have 63 acres of B 376; whilst 3 only now have White Transparent under cultivation with a total area of 46 acres.

The following table shows the increase or decrease in the acreage cultivated in the different seedling and other varieties in 1913:--

Varieties.	*Increase.*	*Decrease.*
D 625	5,760 acres	
Bourbon		617
B 208		1,377
D 145	291	
D 109		591
Diamond 185	154	
Green Transparent ...	366	
B 147 . ..		291
D 118	111	
B 116	51	
Java 100	132	
D 115	13	
D 419	95	
D 74		3
D 4397		6
D 4399		31
B 376		10
White Transparent ...		117

In addition to the above mentioned more important varieties 72 were returned as being under trial cultivation on areas of from one acre to 48 acres each. A very large number of varieties are under trial in the nurseries of the various plantations.

50,602 acres are now occupied by canes other than the Bourbon as compared with 48,633 during 1913, the increase being equal in round figures to 4·5 per cent.

The area occupied by the Bourbon cane has been reduced from 19,250 acres in 1913 to 18,633 for the crops of 1914. The total area under sugar-cane being 69,255 acres, 73·1 per cent. of it is now cultivated in varieties other than Bourbon.

Blackwater Fever.

Dr. J. W. Collett, of Sierra Leone, states that the clinical evidence of blackwater fever cases appears to indicate, with every aspect of certainty, that the disease is due not to any definite, single specific poison, but simply to the establishment of an unstable condition of pressure in the circulation resulting from a variety of causes. Intense or untreated infections of subtertian malaria appear to be one agent which produces this unstable condition of the blood, muscular exertion another, extreme constitutional debility from any cause another, and the administration of quinine in a weakly condition of the body yet another The theory recently advanced that the cause of blackwater is the poison from the bite of some insect needs the support of further evidence to give it *locus standi* with investigators He adds that the condition of pyrexia induced by the absorption of the chemical active rays of light from the sun, and the resulting deleterious effects on the body protoplasm, is a subject that has received scant attention in the past. Only recently has it been appreciated that a number of the so-called local fevers, low temperatures, feeling of malaise and lassitude, and general indisposition are due to light intoxications. The question is of considerable interest and one which will repay careful consideration.

—Colonial Office Journal, June, 1914.

Sargasso Weed.

The Sargasso Sea through which Columbus passed on his first voyage to America is characterized by the scattered masses of gulf weed which float on the surface of the ocean in patches generally from fifty to a hundred feet in diameter. The question as to the origin of the gulf weed has never been definitely settled. Some consider that the gulf weed—whose botanical name is *Sargassum bacciferum*—is merely a mass of sterile branches of some species of *Sargassum* which grows attached in the region of the West Indies.

—"Science," June 5, 1914.

The Cultivation of Vegetables.

By J. F. Waby, F.L.S., F.R.H.S., I.S.O.

PART II.

WE will now mention a few of the best vegetables which are in fairly common demand and for which nothing much more than ordinary cultivation is needed.

Beans. The dwarf French or kidney bean, *Phaseolus vulgaris*, a most desirable vegetable in many hybrid forms, can be grown without much trouble provided the birds are kept away from them; birds attack the young shoots as soon as they are above ground and continue their attacks if allowed to do so till not a scrap remains. They are fairly prolific and each sowing of an ordinary sized kitchen garden bed will supply the table at intervals for several weeks. The seeds should be sown in shallow drills,—2 drills to a bed 5 feet wide,—in 2 rows a few inches apart, 6-8 inches apart in the rows and lightly covered. When they have their first pair of leaves they should be earthed-up, (moulded), *i.e.*, the drills filled up a little higher than the general level of the soil, giving the young plants more stability; beyond an occasional hoeing between the double rows to prevent the soil caking and weeds growing, they will require little more than watering. As soon as the first bed begins to bear, a second should be sown for succession. Pick the beans before the seeds harden.

The tall growing varieties should be planted further apart,—as their tops cover considerably more space,—and sticks provided on which to climb. These last much longer than the dwarf kinds and need not be sown so frequently.

Lima beans, *Phaseolus lunatus*, of various hybrid dwarf forms. These are most delicious vegetables, especially those of the last few years' production, but they are not very prolific in the tropics. They require more room than the French-beans as they make dwarf bushes. Some of the tall-growing forms are worthy of a place in the garden and do even better than the dwarf kinds; like the tall-growing French-beans they require space to spread and sticks for climbing. Lima beans are always used shelled; pick the beans when the seeds are full.

Bonavist beans. *Dolichos Lablab.* The dwarf annual variety is a most useful bean to grow. It makes small bushes, 2 3 feet wide, yielding profusely. Thère are several varieties of climbing perennial Bonavists, mostly with purplish flowers, fairly common, but of a rather coarse nature, lasting with ordinary care through several seasons, requiring a fair amount of space on an outside railing or fence on which to trail,—which are by no means to be despised lacking better material; but one kind especially is worth a place in every garden, *D.L.* var *nankinicus.* This has pure white flowers, the pods short much like green peas, the seeds also like peas, the flavour of which is much more delicate than of any of the others. They can be grown on the palings or fencing of the garden where they exist, or on sticks, or on an arbour; sow 2 or 3 seeds together and give them plenty of room between the sowings. Given fairly rich soil the crop will be good. All Bonavists are used shelled. Pick the pods when they are full, before the seeds get hard.

A VALUABLE NOVELTY.

A form of Dolichos introduced to Georgetown during the past few years from the Interior by Mr. John Park, is a decided acquisition and one of the best which can be grown. Folks from the ' "Old Country" know well their "Scarlet Runners" so much grown in every cottage garden, a standard vegetable for the late Summer and Autumn; this bean easily takes its place both as to its bearing quality and its place at table, used in the same way, *i.e.*, whilst the beans are young and before the seeds are hard. On account of its similarity in these respects it has been named "Scarlet Runner" though its flowers are purplish. Give it plenty of room in a bed and sticks to climb on, or on a fence. The pods must be picked as are those of French-beans so that they will easily slice. It is really the best introduction of late years for the table, equal to French-beans and much less delicate to grow, in fact there is no more trouble with it than with the common Bonavist. It can also be used shelled like the Bonavists.

We will finish the beans with the Goa-bean, *Psophocarpus tetragonolobus*; it is also called, Square-bean, Winged-bean and Sequidilla, introduced a few years since from India. It is a strong climber, well suited for covering palings or outside fences, lasting several years with care, though as seeds are produced in plenty there is no need to keep the plants more

than a year. The flowers are of a pretty blue colour, resembling sweet-pea flowers, borne profusely. The fruit, a square bean about 9 inches long, is 4 winged; the seeds brown, of the size of ordinary peas. The beans must be used when not more than half grown, cut up, or sliced and cooked in the same manner as French-beans, to which they are scarcely inferior. Prepare places liberally supplied with manure, at distances 9-12 feet apart, sow 2 or 3 seeds together and they will soon cover the spaces between •

Cabbage, *Brassica oleracea.* The difficulty with this has been to obtain a variety suited to the tropics. Experiments have been going on for several years for this purpose. The large-headed kinds are of no use; they make a big show forming large plants with large spreading leaves and then fail to "head." The small growing elliptical forms are those to be chosen and these do remarkably well. Forms like the "Jersey Wakefield," especially the improved kind, "Early Jersey Wakefield," have given good results A round-headed form, "Surehead," has done fairly well but nothing to compare with the small elliptical forms; the same may be said of the "All Head" variety The seeds should be sown thinly and the plants pricked off a few inches apart when they have 2-3 leaves; when strong transplant to their permanent positions in drills, giving the plants 9-12 inches each way, alternating in the rows; when they have become established earth up the rows to give stability. The soil must be kept broken up between the plants to prevent caking. They require a free rich soil.

BEET-ROOT

Beet, *Beta vulgaris.* A decided luxury, yet one which can be indulged providing the heavy wet weather does not interfere. It grows sufficiently well to warrant its being more often on the table than it is. Here again the kinds must be chosen with regard to their suitability. It is useless to choose large growing kinds because in the rapid growth induced by the heat they run away to leaf without any enlarged base. The small growing table-beets, such as "Red Globe," "Blood Red Globe," and "Crimson Globe or Ball," should be the kinds tried as these have already given satisfaction. They are delicate plants to deal with and care must be taken with watering. Sow in drills, 6-9 inches apart and when the plants are sufficiently grown for transplanting, thin out in the rows

to 6–9 inches apart, and those which must be pulled out transplant to other beds at a similar distance; whilst the plants are weak give as little water as possible,—though they must not be neglected,—and a little shade would be beneficial. As the balls begin to swell give them a light moulding.

Swiss Chard, or Spinach Beet. This is a kind of beet which does not form a ball at the base. It grows about 1½ feet high with thick, succulent, whitish leaf-stalks and broad crimpled blades. The whole top can be used, stalks and blades separately, forming two separate vegetables; the stalks served as asparagus or Sea-kale, and the blades as spinach. Sow the same as beet, and when strong enough transplant in rich soil about a foot apart. This is not so susceptible of water as beet, and can be freely supplied with it.

Carrot, *Daucus Carota.* This delights in a sandy soil—though not too much of sand; in heavy soil it will "club"; it can be grown all the year round with due regard to succession. Sow thinly in drills, thin out to about 6 inches apart and transplant those taken out of the drills. Choose the short growing kinds, such as "Short-horn," or "Oxheart"; deep rooting kinds are of little use here, except it may be in some of the country districts where the soil is light and deep.

TOMATOES.

Tomato, *Lycopersicum esculentum,* of many hybrid forms and varieties, large and small fruited, and of varying shades of red and yellow. Most of them bear abundantly, some to such an extent that it is advisable to thin out the fruit to ensure the crop being good and well formed. They are strong feeders, therefore the soil must be good, and when in full bearing should be heavily mulched with manure and liberally supplied with water. Sow thinly, either in the open bed, or in boxes, prick out when a few inches high to a few inches apart so as to obtain strong plants, and then transplant to their permanent positions. If left in the seed bed or boxes without being pricked off, they are likely to become spindly and cannot make strong plants as desired. They should be planted at least 3 feet apart, the plants of one row alternating with those of the other; by giving plenty of space between the plants they will branch low and freely, frequently requiring the removal of some of the branches to prevent crowding. The great fault in tomato growing is crowding, it is impossible to obtain good well-formed fruit when this is the case. Do not let the

branches grow long; when 2 or 3 sets of flowers have formed take off the ends, this will keep the bushes fairly low and throw more vigour into the bearing branches. Supports will be needed to prevent the branches breaking down as they are brittle at the joints; these should be arranged so that the branches do not overlap, thus allowing air and sunlight to penetrate freely for the ripening of the fruit. As soon as the first batch is in full fruit sow another set to keep up succession.

Peppers, *Capsicum annuum*, of very many varieties. Grow these in the same manner as the tomato, as they all form compact bushes they do not need supports

Egg plant, Belangine, or Boulanger, *Solanum melangena.* Grow these like the tomato and peppers. Those who like large fruits of a good quality should try the "Black Beauty," it is of a purplish-black colour, globular in form, as large as a small child's head.

Okra, Ochro, Gumbo, *Hibiscus* or *Abelmoschus esculentus.* This is a well known subject, though rarely well grown. It requires similar treatment to the tomato, rich soil and plenty of water. Generally little attention is paid to the Ochro; it is allowed to grow its own way making scraggy, leggy plants which soon exhaust themselves. After they have begun to bear well and whilst they are still vigorous they should be pruned back and made to branch low down thus lengthening the life of the plants and prolonging their producing powers. The pruning must be supplemented with a heavy mulching of manure and copious supplies of water, for they are very thirsty plants. The "Lady's Finger" and "Keckley's Favourite" are the best.

Indian-Kale, *Xanthosoma atrovirens.* This is a dwarf tannia-like plant with small sagittate foliage, grown for the leaves alone and used as spinach when young. Propagate by dividing the stools and plant in rows 6–9 inches apart, and a similar distance between the plants.

Horse-radish, *Cochlearia armoracea*, a deep-rooting perennial. The soil must be dug deeply and made fairly rich; it requires little attention after being planted beyond keeping it free of other plants and the soil kept open. Take off-sets and place well below the surface about 2 feet apart; a

narrow side-bank or ridge is more suitable for this plant than a bed.,

CUCUMBERS.

Cucumber, *Cucumis sativus.* Generally these plants are allowed to run at their own sweet will without any attention whatever beyond watering and perhaps a few sticks on which to trail ; they are however fairly prolific and serve their purpose. Needless to say they require some attention if they are to be satisfactory. The soil must be rich and deeply dug for they are gross feeders. The seeds may be sown at once in the permanent position, but it is usual and preferable to sow in pot or box and transplant when quite strong and before the plants begin to run. A space of at least 6 feet on each side should allowed for each plant ; pinch out the growing point to make it branch and continue pinching as it extends till sufficient branches are formed, removing any which crowd ; laterals will soon appear bearing fruit, take off each point at the first joint past the fruit, retaining the leaf : fertilize each fruit as the flower opens and remove all male flowers not needed for this purpose. Slight shade is beneficial and prevents scorching They are thirsty subjects but water must not be allowed to remain about them A good strain of cucumber is easily kept true to stock by layering and cuttings

SQUASH.

Squash, *Cucurbita melopepo.* Grow this exactly the same as the cucumber, except that it requires a trellis so that the fruit can hang, and the point must not be pinched off till it has reached the height of the trellis, in every other respect treat similarly.

PUMPKIN.

Pumpkin, *Cucurbita pepo.* This is another subject which is always allowed to grow in its own way covering a large space most unnecessarily. Grow this in exactly the same manner as the cucumber and it will be found that a large number of fruits will be borne in a comparatively small space. It is a good subject for an arbour treated as stated for cucumbers.

Lettuce, *Lactuca sativa.* This should be on the table every day and except for neglect in the succession there is but one other reason for this not being the case and that is the failure of seed to germinate which unfortunately sometimes happens.

It must be grown quickly so that it may be crisp and sweet, and for this the soil must be free and rich, otherwise it will be leathery and probably bitter. Sow thinly in a bed or box in fine soil, covering very lightly and water immediately; keep close-shaded for a few days, prick-off as soon as large enough to handle and in about a fortnight afterwards they will be ready to transplant into the beds. Plant in rows 6-8 inches apart each way alternately, shade for a few days. As soon as the plants of the first sowing are established sow another lot for succession. The Cabbage Lettuce is the best to grow, such as "Tom Thumb," "May King," and the "Deacon." Cos Lettuce is not nearly so satisfactory and "runs away" much more quickly, rarely heading.

Radish, *Raphanus sativus* This is the quickest growing esculent we have, giving little trouble; the soil must be free and rich to prevent heat and fibre. Sow thinly in a well prepared bed either broadcast or in drills and just cover the seeds. Keep the soil free and thin out where too thick. Sow a second bed for succession as soon as the bulbs of the first begin to form.

Celery, *Apium graveolens*. Treat the same as Lettuce and when the plants are sufficiently strong transplant to permanent beds 1-1½ feet apart; these will soon be fit for use for flavouring or garnishing. Planting in trenches and earthing up for blanching as is done in Europe is a failure here; the plants grow well for a certain time and give good promise, but if heavy rain sets in the plants are destroyed. A certain amount of blanching may be effected by placing collars of tin or cardboard around the strong plants in the ordinary bed after taking off the bottom leaves, this excludes the light and water does not settle around the plants It is possible that persons living in the country may possess higher land than that about Georgetown, and it would be a good thing to attempt the cultivation of Celery in such land: dig a drill fifteen inches wide and a foot deep throwing the soil out on both sides; dig the bottom a good foot deep and manure heavily; put in the plants 1½ feet apart, when these have grown so that the tops meet, take off a few of the old leaves and mould the plants two or three inches with the soil thrown out by the first digging; as the plants continue to grow keep up the moulding, taking care not to cover the heart of the plants; should there be no heavy rains, or the ground is well drained so that water does not settle in the drill there is the possibility of success.

Report on the Experimental Bleeding of Balata Trees at Onderneeming.

By C. K. Bancroft, M.A., F.L.S., Government Botanist, and S. H. Bayley, Superintendent Onderneeming Farm.

THE following experiments on the bleeding of balata trees were conducted at Onderneeming from July 28th to September 13th by Mr. C. K. Bancroft, M.A., F.L.S., Government Botanist, and Mr. S. H. Bayley, Superintendent of the Onderneeming Farm.

The analyses detailed in the report were made in the Government Laboratory by Professor J. B. Harrison, C.M.G., assisted by Mr. L. S. Davis.

Some determinations of the proportion of balata in the bark of not tapped and tapped balata trees are recorded in the report of the Government Analyst for the year 1884. The data there given can be used as a guide for determining whether in the trials by Messrs. Bancroft and Bayley, the bark was or was not thoroughly bled. The results on dry (moisture free) barks work out as follows:—

	Jenman and Francis.	Bancroft, Bayley and Harrison.
	1884.	1913.
Balata from not tapped area... ...	11·12	14·50
Balata from tapped area, British Guiana method	7·99	4·50
Balata from tapped area, Venezuelan method	...	8·72

It is evident that in the recent trials the balata trees were very skilfully tapped and thus thoroughly deprived of the latex by the British Guiana method; 70 per cent. of the balata in the bark being extracted therefrom as compared with 28 per cent. in the earlier trials.

The experiment had for its object an enquiry into the system of bleeding which is at present in use in this colony and the comparison of the yields obtained by this system with those obtained by other systems, more particularly that which is at present employed in Venezuela. The experiment was conducted at His Excellency the Governor's request and was planned and carried out under the direction of the

Director of Science and Agriculture. It represents, to the best of our knowledge, the first attempt of its kind with respect to a latex-bearing tree in its natural state.

PREVIOUS RECORDS.

For data with respect to the yields obtained from the tree, modes of bleeding, &c., we have consulted "Les Plantes à Caoutchouc et à Gutta" by Jumelle, 1903, "Rubber and Balata in British Guiana," 1911, issued by the Department of Science and Agriculture, and we have had access to various notes and reports in Government papers.

CONDITIONS AFFECTING THE EXPERIMENT.

Under the advice of the Director of Science and Agriculture the place selected for the experiment was an Indian Reserve situated at the back of Onderneeming School Farm. The majority of the trees were growing on a sandy soil ; some were growing in a swamp in pegass. The land was flat or in part very gently undulating.

The average annual rainfall is 96 inches and that for the period of the experiment was 13¼ ins. .

The trees were growing in virgin forest and were all "virgin" trees, i.e., they had not been previously bled. They covered an area estimated at 5 square miles and extended to 3½ miles beyond the back of the Farm.

METHOD OF EXPERIMENT.

The trees were first selected from the point of view of their growth and situation and were grouped together for the different systems of bleeding Adjacent trees were allotted as far as was conveniently possible to different systems, and an attempt was made to obtain a nearly similar girth of the trees for the different systems.

The trees were numbered by means of stencilled labels, and connecting paths were made from tree to tree.

Bleeding was commenced as early as possible in the morning, a greater yield being obtained at this time than during the heat of the day, as is common in other latex-bearing plants. In the case of the trees whose latex was extracted after felling, the felling was done in the late evening and the bleeding carried out the next morning.

The bleeding was conducted by a skilled bleeder of some 20 years' experience. The milk was collected in calabashes, transferred to kerosene tins and transported to the Farm where it was poured into wooden boxes, 1½ x 2 feet, lined with a layer of soap so as to prevent leakage and to permit of the coagulated gum being easily removed. The gum was coagulated by evaporation and removed as a sheet from the box.

The gum was weighed after removal from the box at the end of one week and again at the end of six weeks. The loss of weight on the two weighings was found to be a negligible quantity.

Before the experimental bleeding was commenced, a day was devoted to felling and bleeding a tree and also to bleeding a standing tree so as to ascertain the best plan to be adopted in the experiment. Special knives were also used on preliminary trial. The first experiment was then carried out as follows :—

Twenty trees were employed, grouped into four lots A, B, C and D and numbered A_1, A_2, B_1, B_2, etc. The girths of the trees were taken at 4 feet from the ground, the standard height adopted by the Lands and Mines Department for measuring the girths of the trees, and the distance from the position of the lowest cut on the tree to the fork was measured. The trees were bled to the fork. The process of bleeding consisted in scraping with a cutlass the area of bark to be bled so as to render it smooth, affixing a collecting calabash by raising a portion of the bark and inserting the lip of the calabash between this and the wood of the tree (in the case of a felled tree a calabash was placed below each cut), and then cutting the bark by means of a cutlass or knife according to the method of bleeding employed The same mode of procedure was adopted in experiments 2 and 3.

EXPERIMENT 1.

The experiment was divided into :—

A. Trees bled by a cutlass employing the feather-stitch pattern of cutting on one-half the circumference of the tree as is at present in use in the Colony.

B. Trees felled and bled by the method employed in Venezuela with cuts at right angles to the axis of the trunk Each cut occupied one-half of the circumference of the tree and the cuts on either side of the trunk alternated with each

other. The cuts on each side were 10 inches apart. Each tree was felled at 3 feet from the ground so that its trunk remained propped on the cut end of the stump in order to facilitate bleeding and collecting on the lower part of the trunk. The method which is described by Jumelle was followed as closely as possible.

C. Trees bled by means of a system of connecting V-shaped cuts with a common vertical channel, the cuts being 10 inches apart and occupying one-half of the circumference of the tree. A "pull" knife made locally was employed for making the incisions. (It had been found that a gouge such as is employed in tapping Jelutong, *Dyera costulata*, in the Malay Archipelago could not be employed owing to the fibrous nature of the bark of the tree)

D. Trees bled by means of a herring-bone system with cuts 10 inches apart. The same knife being used as in C. above.

The yields obtained by these methods are shown in Table 1. If the yields obtained by the method at present in use in this Colony be compared with those obtained by the method employed in Venezuela it will be seen that the total difference in yield is 1 lb. 9 ozs. in favour of the latter or a difference of 5 ozs. per tree. The yields obtained in C and D are considerably less than those in A and B. Another method of comparing the yields by these systems, and one which perhaps offers a more favourable comparison, is to accept the area of bark bled as the basis of comparison The area of bark bled was approximately calculated by multiplying the circumference of the tree at 4 feet from the ground, one-half of the circumference, by the height to which the trunk was bled In this way the following results are obtained :—

Approximate yield of dry balata per square foot of bark bled.

A. Local method	...	·16 oz
B. Venezuelan	...	·25 oz.
C. V-system ..	...	·24 oz.
D. Herring-bone system		·24 oz.

EXPERIMENT 2.

Having obtained the above results it was decided to abandon the two systems C and D, as they appeared to yield considerably less than the other systems, and to carry out another experimnet employing both the methods A and B above and

also bleeding standing trees around their whole circumference, in order to compare these latter with the felled trees in B All of the trees were bled by a cutlass. Fourteen trees were allotted to this experiment and these were divided into :—

G. Trees bled by the Venezuelan method as in B above.

H. Trees bled by the feather-stitch pattern around the whole circumference.

X. Trees bled by the method at present in use in the Colony. The trees obtained for X were only four in number and were considerably smaller than those in G and H, and the comparison of the yield of these with the latter trees can scarcely be regarded as fair as regards the actual yields, although the yields obtained from them per area of bark bled is high.

The following yields were obtained :—

G. Five trees (Venezuelan method) 14 lb. 2½ oz.

H. Five trees (whole circumference, standing) 15 lb 5 oz.

X. Four trees (half circumference, standing) 7 lb 11½ oz.

The yield per tree is :—

G 2 lb. 13$\frac{3}{10}$ oz.
H. 3 lb. 1 oz.
X. 1 lb. 14$\frac{7}{8}$ oz.

Calculated on the basis of area of bark bled as in Experiment 1, the results are :—

G .25 oz.
H. .35 oz.
X. .66 oz.

EXPERIMENT 3.

In the two above experiments the trees had been bled only as far as the main fork, as is usually done both in this colony and in Venezuela. It was, however, obvious that the cuts could be extended above the main fork of the tree on the lower parts of the branches both in felled and in standing trees ; and in order to compare the yields of trees bled in this way by the British Guiana and Venezuelan methods, a third experiment was commenced. Only four trees were available for the experiment. The total height of the stem and branches which

was bled, was in the British Guiana method 74½ feet and in the Venezuelan method 97½ feet. The yields obtained were :—

British Guiana method 5 lb. 0 oz.
Venezuelan 4 lb 5 oz.

an excess in favour of the former of 11 oz.

This concludes the actual experiments for comparison of the yields obtained by different systems of tapping, all being based on the extraction of the latex at a single tapping.

EXPERIMENT 4

As an alternative to this an experiment was made to ascertain whether the tree had any wound-response, as occurs in some latex-bearing plants which are exploited commercially at the present day, notably *Hevea brasiliensis* (Para rubber tree) and *Dyera costulata* (Jelutong tree). If any appreciable wound-response was present, the tapping of the tree by opening up the cuts afresh at short intervals of time, would naturally suggest itself as an alternative to the extraction of the latex at one tapping. Accordingly one tree was selected and bled at intervals of 48 hours by means of a basal V-cut 4 feet high, the cut being opened afresh every 48 hours on the upper as well as on the under side. A flow of milk was obtained on the first day, but no further flow was recorded in subsequent tappings. This absence of flow had also been previously indicated by a few trials on some trees in which oblique cuts were made at intervals of 6 inches on the trunk and the intervening portions of bark were again bled on the following day, no flow of milk resulting at the second bleeding

EXPERIMENT 5.

The apparent absence of wound-response is also shown in the following experiment in which an attempt was made to ascertain the maximum distance of the cuts apart which would extract all the available latex from the bark. *i.e.*, which would give a maximum of yield. In this two trees were employed, one measuring 36 inches in girth at 4 feet from the ground and the other 46 inches. V-cuts were made at intervals at 6, 12, 18 and 24 inches in one tree from below upwards and in the other from above downwards. The trees were bled by these cuts and 24 hours afterwards the intervening portions of bark were again cut to ascertain whether there was any flow.

The results obtained agreed in the two trees and were as follow :—

Distance apart of cuts.	*Yield from intervening bark.*
Cuts 24 inches apart.	Good.
,, 18 ,, ,,	,,
,, 12 ,, ,,	Appreciable.
,, 6 ,, ,,	None.

This indicated that the desirable distance of the cuts apart which would extract a maximum of latex was between 6 and 12 inches. Fresh cuts were made at intervals of 8 and 10 inches. In those at 10 inches apart the milk oozed slightly in some cases when the intervening bark was cut, while in those at 8 inches there was no flow.

This concluded the experiments, which have been carried out in order to ascertain data with respect to the bleeding of the tree

CONCLUSIONS BASED ON THE EXPERIMENTS.

The results obtained in the Experments 4 and 5 indicate that there is no appreciable response after wounding the bark of the tree. From this it is indicated that a system by which an attempt was made to extract the latex by paring away the bark at intervals or by bleeding portions of bark intervening between previous cuts would not be successful While the results of Experiment 5 would indicate that a maximum yield can be obtained by bleeding the bark with cuts as far as 8 inches from each other. We also observed that the renewed bark on trees which had been previously bled did not yield freely unless an interval of some years had elapsed. From this it is concluded that it is desirable that the milk should be extracted at a single bleeding as was attempted in the Experiments 1, 2 and 3.

YIELDS OBTAINED FROM STANDING TREES BLED THE WHOLE CIRCUMFERENCE.

Turning then to the results obtained in these experiments, if the results of tapping of trees by the Venezuelan method, by the method now in use in British Guiana and by a modification of the latter in which the whole circumference of the tree was bled, instead of half the circumference, be compared, they show that the greatest yields obtained were by the last named method, and in no case did the yield from the trees which were felled and bled over the whole circumference exceed the yield

obtained from the trees which were bled around the whole circumference while standing in Experiment 2.

THE VENEZUELAN AND THE LOCAL METHOD COMPARED.

The yield obtained from trees bled by the British Guiana method in Experiment 1 gave per tree 5 oz. less of dry balata than those bled by the Venezuelan method; in Experiment 3 they gave 5½ ozs. more per tree; in Experiment 2 they gave 14½ oz. less per tree. In the last named it has been previously pointed out that the trees bled by this system were smaller than those bled by the other system; while the larger trees in the experiments have generally given the greatest yields. If the results of all of the bleedings be taken together the yields obtained per acre are:—

British Guiana method	. .	...2 lb. 0 oz.
Venezuelan method	.. ...	...2 lb. 7¼ oz.

a difference of 7¼ oz per tree. The felling of the tree before bleeding, as is done in the latter system, necessitates the employment of two men, while one can bleed a standing tree. it takes longer to execute and it frequently necessitates the felling of one or more of the surrounding trees so as to allow of a clear space for the tree to fall; it necessitates the conveyance of additional implements, viz., axes, calabashes or collecting vessels. All of these render collection of milk more difficult. Further it destroys the tree, the value of which for timber in this colony is well known In order, therefore, to compensate for the difficulties ensuing in this method of extracting the latex, very large yields should be obtained. The experiments do not indicate that comparatively large yields are obtained by this method.

TAPPING THE WHOLE OR HALF OF THE CIRCUMFERENCE OF THE STANDING TREES.

The tapping of the whole circumference of standing trees may be expected to be more injurious than the tapping of one-half of the circumference; while in the hands of other than a careful bleeder it may easily result in the death of the tree. The tapping of one-half the circumference of a tree by the local method is the most efficient system, yielding far greater than any of the others per area of bark bled.

HERRING-BONE AND V-SYSTEMS OF TAPPING.

The yield obtained by these systems were comparatively low This may be due partly to the fact that the bleeder was not

sufficiently skilled in the use of the knife. The yields obtained are so low that they indicate that the V-systems which are employed in tapping plantation Para and other plantation rubber trees are unsuited to the bleeding of the bullet tree.

THE USE OF THE CUTLASS AND THE KNIFE.

Trials were made with three knives—one a "pull knife" made locally under our direction, another a simple gouge, and a third knife obtained from Surinam for which good results had been claimed. Our observations showed that the use of a gouge was not practicable owing to the fibrous nature of the bark, while a greater yield was clearly indicated by the use of the locally made knife than by the Surinam knife. When compared with the cutlass we found that a knife tends to tear the bark and does not make a clean cut; this is due to the fibrous nature of the bark. And further, with the cutlass a vertical as well as a horizontal cut is obtained, so it may be expected that a larger number of latex cells are opened with the cutlass than with the knife. The cutlass is easy to use at heights on the tree and it is cheap and can be easily sharpened; while with ordinary care our observations showed that it does not penetrate to the wood of the stem. Its use is in our opinion preferable to that of a knife.

DISTANCE OF THE CUTS APART

It is concluded that a vertical distance of between 8 and 10 inches apart of the cuts will extract a maximum quantity of milk.

ANALYSIS OF BARKS AND BALATA.

In addition to the experiments on the bleeding of the tree as set forth in the above, analyses of the bark and of the balata from different trees have been made The primary object of these analyses was to ascertain whether any evidence could be adduced from them in support of the conclusions drawn frem the experiments on bleeding. The following analyses were made :—

(*a.*) Three samples of bark taken from the bottom, (2½ ft. from the ground), middle and top (at the main fork) of the trunk of a tree which had been felled for the purpose in the area in which the bleeding experiments were being conducted. The samples were obtained by removing an area of bark 18 inches in length, the whole circumference of the tree in width and the whole of its depth from the surface to the underlying wood and were placed in sealed kerosene tins. The analyses were made from portions taken from the middle of the samples

so as to avoid any errors which might be due to loss of milk from the incisions made in removing the bark. The results of the analyses were :—

	Moisture %.	Gutta %.	Resin %.
Bottom of tree	53·00	2·54	2·68
Middle of tree	54·00	2·85	2·90
Top of tree	62·40	2·14	2·18

(*b*.) Two samples of bark were taken after the tree had been bled by the Venezuelan method—at different parts of the stem the one higher than the other. The average of the two analyses were :

Moisture %.	Gutta %.	Resin %.
61 0	1·34	1·91

(*c*.) Two samples were taken as in (*b*) from a tree after it had been bled by the British Guiana method The average of the two was :—

Moisture %.	Gutta %.	Resin %.
62 0	68	1·58

(*d*.) Samples of balata were taken from trees tapped by different systems and were analysed for the percentage of moisture, resin, gutta and impurities. The results were as follow :—

ORIGIN OF SAMPLE

	Moisture %.	Gutta %.	Resin %.	Impurities %.
Tree bled by British Guiana Method				
	7 20	39 26	41·62	11·92
	7 30	40 59	40·13	11·98
Means ..	7·25	40·42	40 87	11·96
Tree bled by Venezuelan Method				
	4 30	38 51	43 71	13 48
	6·40	41·30	38 29	14·01
Means ...	5·35	39·90	41·00	13 74
Tree bled on V-system.				
	5·30	35·11	48·69	10 90
	5·40	39·57	41 81	13·22
Means ...	5·35	37 34	45·25	12·06
Tree bled by Venezuean Method				
	5·20	36·08	45·25	12 45
	8·80	37·41	46·27	14·69
Means ...	7·00	36·74	39·10	13 57
Tree bled by British Guiana Method on the whole circumference.				
	9·00	41·64	38·82	10·54
	2·20	45·20	43·50	9·10
Means ...	5·60	43·42	41·16	9·82

CONCLUSIONS BASED ON THE ANALSYES.

The following conclusions are deduced from the results of these analyses :—

The results of the analyses of the samples of balata were employed to calculate a *normal* balata the approximate composition of which was arrived at by taking the mean of the analyses of the samples in *d* and is as follows :—

Moisture.	Gutta.	Resin.	Impurities
6·1	39·5	42·2	12·2

Employing this normal balata of the above composition as a basis of calculation it is possible to estimate the amounts of balata in the barks which were analysed in *a*, *b* and *c* above, from their gutta content. These balata contents are then :—

		Normal Balata Content of the bark.	
a. Tree not tapped—Bottom	...	6·4 %	
Middle	. .	7·2 „	6·3 % average.
Top	...	5·4 „	
b. Tree after having been bled by Venezuelan Method	...	3·4 %	
c. Tree after having been bled by British Guiana Method	...	1 71 „	

From these results the residue of balata in the bark after bleeding is considerably less when the British Guiana method is employed than when the Venezuelan method is employed. In other words they indicate a greater efficiency of extraction from the former method than from the latter and support the conclusion arrived at from the results of the bleeding experiments.

This is the main point which is borne out by the above analyses. Some other facts, however, which may prove of more than scientific interest are indicated in the analyses. Such are the difference in the relative proportions of gutta to resin in the bark before and after tapping, as is indicated in *a*, *b*, and *c* above the difference in the relative proportions of gutta to resin in balata yielded by systems of different degrees of efficiency as is indicated in *d*, the difference in the content of normal balata in parts of the bark as indicated in *a*. These must form the basis of further research at some future time, inasmuch as they may throw some light on the part played by these substances in the economy of the life of the plant of the nature of which there is at the present little known.

OTHER CONCLUSIONS.

With respect to the time of healing of the wounds made by bleeding we are unable to furnish any information, as the experiments have only been recently conducted. If bleeding is conducted with ordinary care there appears to be no exposure of the wood to decay induced by water or to the attacks of insects. The fact that trees have been bled on renewed surfaces of bark in certain parts of the colony indicate that with care a good renewal of the bark can be obtained.

The use of stirrups for climbing the trees should be prohibited owing to the unnecessary wounding caused thereby. There would appear to be little difficulty in climbing by means of a ladder and rope.

YIELDS PER TREE.

The average yields per tree in the experiments from the better systems of tapping vary from 1 lb. 14 oz. to 3 lb. 1 oz. The greatest yield obtained from any one tree was 4 lb. of dry gum. It may be said that in the experiments the yields of the trees were fairly uniform. In "Rubber and Balata in British Guiana" the average yield per tree is given as 5 lb.; while in a good season it is said that 25 lb. per tree has been obtained. Jumelle gives the amount taken from trees in Venezuela as a little less than 5 lb. a tree. And on enquiry we have ascertained that 5 lb. a tree is regarded as a good yield.

SPECIES OF BULLET TREES.

Two distinct species of bullet trees were noticed, the most obvious distinguishing character being the sizes and shape of the leaves. Both species appear to be exploited commercially for balata in this colony. Specimens of both of these have been sent to Kew for identification.

BALATA EXPERIMENTS.—Table I.

Mark.	Girth 4 ft. from ground.	Height tapped.	Yield of dry gum. lbs.	ozs.	Remarks.
A 1	54 inches	30 feet	1	8	These trees tapped by methods usual in British Guiana, half circumference of tree only
A 2	63 „	30 „	2	11	
A 3	37 „	32 „	1	2	
A 4	45 „	28 „	2	1	
A 5	57 „	32 „	2	1	
Totals	256 „	152 „	9	7	
Average	51 „	30⅖ „	1	14	
B 1	51 inches	34 feet	2	9	Tapped in Venezuelan method, viz., tree felled and ringed.
B 2	44½ „	38 „	2	6	
B 3	56 „	37 „	2	7	
B 4	43 „	31 „	1	9	
B 5	44 „	35 „	2	1	
Totals	238½ „	175 „	11	0	
Average	48 „	35 „	2	3	
C 1	55½ inches	25 feet	1	1	These trees tapped with a patent knife—V's.
C 2	38 „	25 „		11	
C 3	46 „	26 „		10½	
C 4	42 „	25 „		8½	
C 5	35 „	26 „	..	8½	
Totals	216½ „	127 „	3	7½	
Average	43 „	25⅖ „	.	11	
D 1	6 inches	25 feet		13	Tapped with patent knife—herring-bone
D 2	38 „	25 „		13	
D 3	40 „	26 „		14	
D 4	35 „	26 „		6	
D 5	37 „	26 „		10½	
Totals	212 „	128 „	3	8½	
Average	42 „	25⅗ „		11	

BALATA EXPERIMENTS.—TABLE II.

Mark.	Girth 4 ft. from ground.	Height tapped.	Yield. lbs.	ozs.	Remarks
G 1 ..	42 inches	47 feet	2	3	These tapped the whole circumference by Venezuelan method.
G 2 ...	55½ ,,	37 ,,	1	14½	
G 3 ...	51 ,,	43 ,,	4	0	
G 4	45½ ,,	40 ,,	2	4	
G 5 ...	69 ,,	40 ,,	3	13	
Totals	254 ,,	207 ,,	14	2½	
Average	50⅘ ,,	41⅖ ,,	2	13 3/10	
H 1	58 inches	37 feet	3	15½	These tapped the whole circumference by British Guiana method.
H 2 ..	57 ,,	30 ,,	2	15	
H 3	36 ,,	34 ,,	2	4½	
H 4	61 ,,	30 ,,	4	0	
H 5	45 ,,	25½ ,,	2	2	
Totals	257 ,,	156½ ,,	15	5	
Average	51⅖ ,,	31 3/10 ,,	3	1	
X 1	41½ inches	27 feet	1	11	These trees tapped by methods usual in British Guiana—half circumference, standing.
X 2	43 ,,	28 ,,	2	11½	
X 3	36 ,,	27 ,,	1	10½	
X 4	39 ,,	30 ,,	1	10½	
Totals	159½ ,,	112 ,,	7	11½	
Average	39⅞ ,,	28 ,,	1	14⅞	

BALATA EXPERIMENTS—BRANCH TAPPING—TABLE III.

Mark.	Girth 4 ft. from ground	Height tapped. Stem.	Branches.	Total height	Yield. lbs.	ozs	Remarks.
		f.	ft.	ft.			
P 1 ...	38 inches	33	5	38	2	13	These were bled by the British Guiana method.
P 2 ...	45 ,,	28½	8	36½	2	3	
Totals ...	83 ,,	61½	13	74½	5	0	
Average ...	41½ ,,	30¾	6½	37¼	2	8	
Q 1 ...	38½ inches ..	37	13	50	1	14	These were bled by the Venezuelan method.
Q 2 ..	47 ,,	40	7½	47½	2	7	
Totals ..	85½ ,,	77	20½	97½	4	5	
Average ..	42¾ ,,	38½	10¼	48¾	2	2½	

Report on Experimental Tappings of Balata Trees.

By C. Wilgress Anderson, I.S.O., Forestry Officer.

THE following is a report on the results of experiments made in the tappings of balata or bullet trees (*Mimusops globosa*) to ascertain the comparative yields of balata from these trees when
(1.) Tapped standing in the usual way.
(2.) Tapped felled.

SITUATION OF TREES.

The trees tapped were growing in the forest of the Indian Reservation at Wikki on the right bank of the Berbice River. The soil was a mixture of sand and clay and the land naturally drained. They were approached by the way of the Sari creek from a landing from which a trail had to be cleared through the forest to where the trees were growing.

An Indian benab built on the banks of the creek within an hour's walk of the trees afforded accommodation for myself and the Indian labourers as well as a shelter for storing the latex collected.

LABOUR

The Indians at the Wikki Mission had, on my arrival there, already started tapping balata trees on their own account in the forests of the Reservation. Aft r some delay in sending for them, I secured the services of four there and of two others from the vicinity above the Mission, all of whom were expert balata "bleeders."

I arranged to pay them by the results of the balata obtained and in addition a daily wage while working as boathands and transporters. I may mention here that labour of any kind is scarce and difficult to obtain on the upper Berbice river.

PERIOD OF YEAR SELECTED FOR TAPPING.

The tappings were made in July last, a favourable time of the year for the tapping of the trees as the latex then usually flows readily. While engaged on the work rain fell at frequent intervals but at no time was the rainfall so prolonged as to interfere with the tappings or to cause loss in collecting the latex. During the dry season no flow of latex is obtainable from the trees.

TAPPINGS.—BRITISH GUIANA METHOD.

Of the twelve balata trees available, six were tapped *standing* with criss-cross excisions at intervals of about 10 inches apart extending half-way round the circumference of the trunks, in the usual way adopted in the colony for "bleeding" balata trees.

VENEZUELAN METHOD.

Six others were felled and tapped prostrate with excisions extending as far as practicable entirely around their trunks at distances of about 12 inches apart. Between these cuts oblique excisions were made so as to exhaust all the latex contained in the bark.

THE LATEX COLLECTED.

The latex obtained from each of the trees tapped was separately measured in imperial pints and parts of a pint. It was found impracticable, under the conditions obtaining, to separately dry the latex collected from each of the trees tapped. It was transported to the open lands at Wikki Mission in suitable vessels where it was poured into a shallow wooden tray prepared for the purpose and dried there by exposure to the heat of the sun. To prevent sticking, the bottom of the interior of the tray was rubbed over with a thin layer of soap.

THE BALATA.

As soon as the exposed latex was sufficiently dried, the balata was removed in the form of thin sheets, each sheet so removed being hung dry-side downwards on a line, under shelter, until the soft under-surface had also become dried. This process was repeated during a period of 9 days when the last sheet was removed from the bottom of the tray. In all, six thin sheets of balata measuring about 6½′ x 2′ were produced in this way which together weighed 55 lbs., including a small quantity of scrap found adhering to the tray These sheets are excellent specimens of balata. They are quite clean and free from extraneous matter with the exception of the one first taken off, scattered on the surface of which are small particles of chipped bark which could not be removed without loss of latex

RESULTS OF THE TAPPINGS.—YIELD IN BALATA FROM LATEX.

The results of the tappings have been tabulated in detail on the form attached to this report on reference to which the yields of latex and balata obtained by the two methods of tapping

employed can conveniently be compared. For the reasons explained in paragraph 6, the quantity of balata obtained from each of the trees has not been separately recorded. The yield in balata assigned to each tree on the tabulated form has been calculated in proportion to the yield of latex obtained from it, the value determined of one pint of latex, as derived from the total weight of balata obtained when dried for transport, being 0.7 or 7/10 of a pound avoirdupois of balata. (As worked out the exact figures are 0·699 lbs. = 1 pint).

LOSS OF WEIGHT IN SHRINKAGE.

After transportation from the interior of the colony there is invariably a difference between the weights of the balata as determined at the up country depôt and those registered after the arrival of the balata in Georgetown. This is mostly due to shrinkage in weight by subsequent further drying. In the case of my experiments the shrinkage in weight was found to be as follows:

1. Weighed on 9th August after sufficient drying for transportation, 6 sheets and scrap ...55 lbs.
2. Weighed on 16th September after further drying during transportation and while in town 54 ,,
3. Weighed on 15th November after being stored in town ... ...52.5 ,,

Loss in shrinkage of weight ... ... 2.5 ,,

or 4·54 per cent. of total weight when dried for transportation.

YIELD OF TREES TAPPED STANDING AND TREES TAPPED FELLED COMPARED.

Referring back to the main object for which the experiments were made the results shew that the opinions recently expressed, viz:—"that a far greater yield of balata could be obtained if "the method of tapping trees felled were permitted instead of "tapping them standing, as prescribed by the Crown Lands "Regulations," are obviously erroneous as will best be seen from the following summary*:—

NOTE:—* "It will be observed on reference to the tabulated form that the yields of the trees tapped standing vary considerably, the maximum yield in balata being 7.70 lbs. and the minimum 1.33 lbs. per tree The average yield of six trees was 5.59 lbs of balata per tree. Cuts made in the trees two or more days after tapping showed no wound response. The flow of latex from the later cuts being inappreciable, or none at all.

		Lbs. of Balata.
1.	Yield ef six trees tapped standing with excisions extending half-way around trunks...	33·5
2.	Yield of six trees tapped felled with excisions extending completely or nearly entirely around the trunks	21.5
	Difference in favour of (1)	12 lbs.

or 36 per cent. gain in balata.

Presuming that the trees if tapped standing around the whole circumference of the trunk would yield twice the amount of latex than when tapped only half-way, the gain in balata would then be as much as 68 per cent. more than that yielded by the felled trees. I may mention here that the Indians employed on the work predicted a smaller return from the trees tapped felled than from those tapped standing. In addition, the felling of the trees involves much more labour, harder work and loss of time, than is required to tap them standing,† with the aid of a rope known as the "vention" or "invention."

WOOD OF BALATA TREES.

Lastly, the felling of the trees would cause great waste of valuable wood, which, were transport facilities available, should find a ready sale.

TAPPING IMPLEMENTS.

So far, the cutlass, in the hands of a trained "bleeder," has proved to be the best implement for the tapping of the trees. I have seen many trees that had been tapped with it on which the excisions were, after a lapse of time, completely healed. The so-called Surinam "safety knife" is crude, clumsy and ill-balanced, not easy to sharpen, and, unless kept sharp, tears the fibrous bark of the balata trees. I had a trial made of one by the Indians, who found it awkward to manipulate while using the rope in the tapping of a tree, It was only found of use for the making of cuts in the bark underneath a felled tree where the space between the ground and the trunk was not sufficient to permit the use of a cutlass.

† A medium sized tree was tapped by an Indian with the aid of a rope, as far up as the branches in twenty minutes.

CONDITIONS AND METHODS OF TAPPINGS SIMILAR TO THOSE USED ON BALATA TRACTS.

In the experimental tappings under report, similar conditions prevailed, and the methods adopted were the same‡ as those employed by labourers working on the balata collecting tracts in the colony. The data here determined may be therefore considered as being fairly representative in every way, of the results generally obtainable by those engaged in the balata industry.

CONCLUSIONS.

From the data obtained from the experiments as recorded in this report, it is clearly evident that the mode of tapping adopted in British Guiana, as prescribed by the Crown Lands Regulations, is in every way the most economical both with respect to the yield of the balata obtained and with regard to safeguarding, as far as possible, the lives of the trees for possible future tappings, while, on the other hand, the Venezuelan method of felling the trees for tapping not only yields a very much smaller quantity of balata, as compared with the British Guiana method, but also involves the destruction of the trees.

‡ Except the felling of the trees, which is prohibited.

Tappings of Balata Trees in the forests around the Sari Creek, a tributary on the right bank of the Parway Creek and within the Indian Reservation at Wikki, Berbice River.

No. of Tree.	Girths of Trunks. Where cut or above Buttresses.	At first branch.	Mean Girths.	Length of trunk tapped.	Yield in Pints of Latex. Trunk.	Stump and branches.	Total.	Yield of dried Balata.	Average surface of bark per tree.	Yield of dried Balata per square foot of bark.	Notes and Remarks,
	ins.	ins.	ins.	ft.	Imperial pints			lbs.	sq. ft.	lbs.	
	Trees Tapped Standing. ½ Circumference.										
1	99·	Approximate. As deduced from	Measurements of felled trees.	50·	7·5		7·5	5·25			All of these trees were tapped with the usual criss-cross excisions extending half-way around the circumference of their trunks and in accordance with the method prescribed by the Crown Lands Regulations.
2	78·			45·	13·5	...	13·5	9·45			
3	101·			45	6·75		6·75	4·73	288·76 ÷ 2	½ circumference.	
4	90·			45·	11·0		11·0	7·70			Girth around buttress, 108 inches.
5	46·			35·	1·9	..	1·9	1·33			Tapped by Indian in about 20 minutes.
6	89·			50·	7·25		7·25	5·07			Previously tapped ¾ around at bottom and about half-way around up part of the trunk about 15 years ago. Although quite healed, marks of old cuts still discernible.
Total .	503·	...	...	270·	47·9	.	47·9	33·53†			
Mean .	83·8	70·2	77·0	45	7·98		7·98	5·59	144·38	0·03877	These results are from a single tapping of each tree.
	Trees Tapped Felled									·6192 ozs.	
1	77	66	71·5	36·	3·75	1·25*	5·0	3·5			Tapped with ring cuts around trunks 10 to 12 ins. apart, with oblique excisions extending between rings.
2	72	53·	62·5	59	3·0	1·0	4·0	2·8			Trunk split from fall up to 14 feet from stump. Height of stump 3 ft. above ground
3	60·5	48	54·25	33·	3·0	1·5	4·5	3·15			
4	75	69	72·	36	5·2	not tappable	5·2	3·64			Bark varies from ¼ to ½ inch in thickness.
5	81	72	76·	69	6·3	0·12	6·42	4·49			Trunk hollow throughout, bark about ¼ inch, height of stump 3 feet above ground. Felled evening before tapping
6	89	72	80·5	57	4·25	1·4	5·65	3·95			Trunk previously tapped up to 20 ft. above ground and about 21 in. around. Stump 3½ ft. above ground. Bark ¾ inch in places to ½ inch thick.
Total .	435·5	380·	416·75	290·	25·5	5·27	30·77	21·53†		(·2048 ozs.)	
Mean ..	75·6	63·6	69·46	48·34	4·2	0·88	5·13	3·59	46·63	0·0128	

* Latex obtained mostly from stumps.
The branches were, from the force of the fall of the trees, so broken and smashed as not to be tappable to any extent.
† Decrease in weight of Balata from 55 lbs. 9th August, to 52·5 lbs., 15th Nov.,=4·54 per cent.

Cacao Experiments, 1913.

By J. B. Harrison, C.M.G., M.A., and S. H. Bayley,
Superintendent, Onderneeming School Farm.

DURING the four years 1910 to 1913 inclusive the various plots of cacao trees on the manurial experiment-field were either left unmanured, were heavily mulched or were manured each year. The resultant crops have been dealt with in previous numbers of this Journal, the results of the trials in 1912 being recorded on pp. 39—43 of Vol. VII for July, 1912. As, however, with permanent products such as cacao the effects of manuring cannot be regarded as terminating with the years of application, it is necessary to ascertain and record the yields from the various plots during succeeding years. This has been done for 1913, and is in course of record for 1914.

During the year 1913 the returns of wet cacao from the manurial experimental field at Onderneeming School Farm were as follows :—

YIELDS OF WET CACAO OR "PULP" PER ACRE.

Plots.		*Yields.* Lbs. per Acre.	*Probable error excess or deficit.* Lbs. per Acre.
Nos. 1, 4, 7, 11 & 16	No manure ...	1,000	41
Nos. 3, 8 & 13 ...	Heavily mulched ...	1,290	90
Nos. 12 & 18 ...	Sulphate of ammonia only ...	964	77
Nos. 6 & 14 ..	Superphosphate of lime and sulphate of potash ...	1,518	175
Nos. 5, 10 & 15 ..	Superphosphate of lime and sulphate of ammonia . .	1,088	128
No. 9 ..	Sulphate of potash and sulphate of ammonia ...	1,181	128
Nos. 2 & 17 ...	Superphosphate of lime, sulphate of potash & sulphate of ammonia ...	1,259	95

These returns are equivalent—on the assumption that (as in

our large scale determination in 1902) the "pulp" yields 36·6% of its weight of cured cacao—to the following :—

Plots.		Cured Cacao: Lbs. per Acre. *Yields.*		*Probable error: excess or deficit.*
Nos. 1, 4, 7, 11 and 16	...	366	...	15
Nos. 3, 8 and 13	...	472	...	42
Nos. 12 and 18	...	353	...	28
Nos. 6 and 14	...	555	...	64
Nos 5, 10, and 15	...	398	...	48
No. 9	...	432	...	47
Nos. 2 and 17	...	468	..	35

During the year the mean yields on the mulched plots were somewhat less than on those which had received superphosphate of lime and sulphate of potash. The manuring with superphosphate of lime and sulphate of ammonia and that with sulphate of potash and sulphate of ammonia produced but little increase which, under the conditions of the trials, could be safely ascribed to the previous manurings A beneficial residual action was indicated where superphosphate of lime, sulphate of potash and sulphate of ammonia had been applied, whilst where the purely nitrogenous manure, sulphate of ammonia, had been applied alone the yields were a little lower than the mean yield of the unmanured plots.

During the five years—1909 to 1913 the totals of the crops of wet cacao were as follows —

Plots.			Wet Cacao: Lbs. per Acre. *Yields.*	*Probable error: excess or deficit.*
Nos. 1, 4, 7, 11 & 16		No manure ..	5,762	196
Nos 3, 8 & 13	...	Heavily mulched ...	7,482	289
Nos. 12 & 18	...	Sulphate of ammonia only ...	5,440	426
Nos. 6 & 14	...	Superphosphate of lime and sulphate of potash .	7,492	460
Nos. 5, 10 & 15	...	Superphosphate of lime and sulphate of ammonia ..	6,560	485
No. 9	...	Sulphate of potash and sulphate of ammonia ...	6,208	596
Nos. 2 & 17	..	Superphosphate of lime, sulphate of potash and sulphate of ammonia	6,801	271

These correspond to the following returns of cured cacao per acre :—

		Cured Cacao : Lbs. per Acre.	
Plots.		*Yields.*	*Probable error : Excess or deficit.*
Nos 1, 4, 7, 11 & 16	..	2,080	.. 71
Nos. 3, 8 & 13		2,699	... 113
Nos. 12 & 18	...	1,963	.. 155
Nos 6 & 14	..	2,705	... 154
Nos. 5, 10 & 15		2.375	... 213
No. 6		2,242	. 217
Nos. 2 & 17	.	2,465	. . 99

These results show that taking into account the probable errors of the trials the highest total yield of cacao during the five years has been on the heavily mulched plots on which there has been a minimum increase of about 435 lbs. of cured cacao or about 84 lbs. per acre per crop over the mean yield of the five non-manured plots. But the cost of the mulching to produce 435 lbs. of cacao, worth say $52, was approximately $66.

On the other hand the application of sulphate of potash and superphosphate of lime, costing approximately $14 during the five years, has given a minimum increase of 400 lbs. of cacao, worth, say $50.

The quick-acting nitrogenous manure used—sulphate of ammonia—somewhat lessened the yields both when applied to otherwise unmanured land, and when added to manurings of superphosphate of lime and sulphate of potash.

The application of lime to the land has not had any beneficial effect, the weight of wet cacao produced on the 18 plots of limed land during the five years having been 6,503 lbs. per acre as compared with 6,574 lbs per acre yielded by the 18 plots of not-limed land.

EFFECTS OF REDUCING THE DENSITY OF SHADE.

Between November, 1900 and May, 1902 the shade-trees on the cacao fields were largely removed. On an area of about two acres of one of the southern fields the shade-trees were not cut out. At the same time the methods of cultivation were changed and instead of the haphazard want of system that was in force prior to the cacao fields coming under the control of the Agricultural Department the fields have since been

carefully cultivated, the trees pruned, and a persistent look-out kept for pests of various sorts. Under these conditions the returns have greatly increased. The yields steadily increased from a mean annual yield of 1,064 lbs. during the five years prior to the thinning of the cacao trees and during the past five crops at the following rates :—

		Cured Cacao.
		Lbs.
1909	.	4,774
1910	..	5,582
1911	...	4,970
1912		4,451
1913		4,945
	Mean	4,944

The mean annual increase of 3,880 lbs. of cured cacao was due to the three factors of lessening the shade, adequate tillage and care of the cacao trees, and improved drainage. Until the increase became fairly constant it was, of course, not possible with any approach to reliability to differentiate the effects due to lessening the shade from those of the other factors.

The yields having approached a fair degree of constancy— the falling-off in 1912 being due to the drought of 1911-1912 —a commencement was made in January 1913 to determine the results due to the lessening of the shade as apart from the other improvements. This is being done by recording the yields of cacao from the area on which the shade-trees were not thinned out, and from the adjacent parts on the cacao field on which the shade-trees had been largely reduced. Four hundred and fourteen cacao trees are growing on the former and 586 on the latter.

The returns from the heavily shaded and the lightly shaded areas were at the following rates :—

PER ACRE OF 300 TREES.

		Number of Pods.		*Pounds of Pulp.*
Heavily shaded	...	5,889	...	1,204
Very lightly shaded	..	9,546	...	1,823

The yield from the very lightly shaded areas was at the rate per acre of 3,657 pods and 619 lbs of pulp, equivalent in round figures to 2 cwt. of cured cacao in excess of that from the heavily-shaded part.

The mean annual increase of cured cacao per acre from 1910 to 1913 over that for 1897 to 1900 has been, in round figures, 3,800 lbs This was the increased product of 3,186 bearing trees of which 413 were heavily shaded. Three hundred trees not shaded would have given an increase of 349 lbs. or, say, 3½ cwt. of cacao per acre.

These details indicate that the increased yields may be due to the various treatments in the following proportions :—

	Dry Cacao per acre.
To removal of shade	2 cwts.
To improvements in cultivation and drainage	1½ „
	3½ cwts. per acre.

The experiments have indicated that in British Guiana under conditions similar to those existent at Onderneeming farm, the methods of cultivation precedent to the successful growth of cacao are :—

1 The reduction of "shade" to the lowest amount compatible with due protection from wind.

2. Deep and efficient drainage, certainly not less than from 3 to 4 feet.

3. Annually forking the land between the trees in such a manner as not to injure their roots more than is absolutely unavoidable, whilst effectually loosening the soil for æration and drainage and thus constantly adding to the depth of tilled surface soil and the feeding area available for the roots of the trees. To do this requires the services of skilled forkers working under strict supervision.

4. Mulching the soil, but only so far as can be done at a low cost per acre ; such cost not exceeding, say, $6.

5. Manuring the trees with a mixture of superphosphate of lime and sulphate of potash. The cost of such application should not exceed $4 per acre.

The results of the experiments carried on from 1903 to 1913 point out that in future trials attention should be directed towards a comparison of manurings with phosphates and potash, with and without heavy mulchings, and of heavy mulchings without manuring.

The Crops on the Experimental Sugar-Cane Fields, 1913.

By Professor J. B. Harrison, C.M.G., M.A., F.I.C., Director C. K. Bancroft, M.A., F.L.S., Government Botanist, and R. Ward, Agricultural Superintendent, Department of Science and Agriculture

The crops grown on the Experimental Sugar-cane Fields were reaped in December, 1913, and January, 1914. The general results of these crops are shown in the following notes :—

THE RAINFALL.

The rainfall during the year 1912, and during the year 1913, as recorded at the Experimental Fields, the average monthly rainfalls on them during the year 1901–1912, and the differences of rainfalls during 1913, in excess of or in deficit from the average monthly rainfalls of 1901–12 and those of 1913, are shown by the following :—

RAINFALL IN INCHES

Months.	*1913*	*1912.*	*Averages 12 years 1901-1912.*	*Differences of 1913 from 1912.*	*Differences of 1913 from average of 12 years.*
January	16.67	1.23	6.80	+ 15.44	+ 9.87
February	1.99	.46	5.17	+ 1.53	– 2.48
March	6.34	1.28	9.43	+ 5.06	– 2.09
April	1.74	6.21	7.70	– 4.47	– 5.96
May	4.10	9.08	12.02	– 4.98	– 7.98
June	10.82	8.21	11.80	+ 2.61	– 2.98
July	13.91	11.24	10.19	+ 2.67	+ 3.72
August	6.03	8.17	7.29	– 2.14	– 1.16
September	3.22	1.57	3.94	+ 1.65	– .74
October	3.47	1.89	2.39	+ 1.58	+ 1.08
November	2.27	4.03	4.71	– 1.76	– 2.44
December	15.91	16.45	10.65	– .54	+ 5.26
Totals ...	86.45	69.82	92.39	+ 16.63	– 5.94

The year was characterised by heavy rains in the month of January, a continuation of the heavy rainfall (12.58 inches) of December, 1912. February was a dryer month than was desirable ; the rainfall in March was seasonable ; April and May were dryer than desirable in the interests of the sugar-cane crop ; the rainfall during June, July, August, September and October was seasonable and satisfactory ; November was

dryer than desirable, whilst the rains in December were somewhat too heavy. On the whole the amount and distribution of the rainfall was satisfactory and such as to ensure favourable growth.

The whole area of the sugar-cane fields having been reaped in December, 1912, it was not feasible to cut any canes in May or June, 1913.

YIELDS OF VARIETIES.

The yields of varieties may be conveniently compared with those of Bourbon canes growing on land which had been rested from Bourbon for several years. The average yields and characteristics of the expressed juices of the varieties under the various conditions of manuring used in the large plot series of trials were as follows :--

		Juice.		Saccharose in Juice.	
Variety.	*Tons Canes per acre.*	*Per cent. of Canes.*	*Specific Gravity.*	*Lbs. per gallon.*	*Tons per acre.*
D 721 ...	31 3	69 6	1.0787	1.793	3.62
D 118 ...	24 2	67.8	1.0846	1.986	2.98
D 625 ...	24.9	72.0	1.0769	1 728	2 91
D 167 ..	24.1	68.4	1.0787	1.833	2.79
D 317 ...	25 0	66.7	1.075	1 792	2 78
D 651 ...	21.5	71.0	1.0795	1.884	2.66
D 246 ...	20.9	68.2	1 079	1.895	2 50
D 420 ...	22.5	67.3	1.0785	1 575	2.49
D 4397	22.9	68.9	1.071	1 642	2.42
D 44 ..	22.8	65.4	1.0755	1.728	2.40
D 642 ..	19.1	73.4	1.0735	1.778	2.36
D 133 ...	22 3	66.3	1.080	1.715	2.35
D 490 ...	20.1	68.6	1.076	1.798	2.31
D 398 ...	19.2	68 7	1.0717	1.695	2.09
D 333 ...	18 2	66.9	1.079	1.848	2.08
D 4399 ..	18.9	66.8	1.074	1.704	2.00
D 639 ...	16.5	68.2	1.0705	1.634	1.89
D 419 ...	16.0	68.3	1.0815	1.798	1.82
D 405 ...	19.5	59.4	1.072	1.676	1.81
D 335 ...	15.5	71.9	1.0775	1.754	1.81
D 305 .	16.7	66.4	1 072	1.689	1.74
D 426 ...	16.1	67 1	1.0765	1.692	1.70
D 454 ...	12.9	67.4	1.0777	1.334	1.48
D 145 ...	13.5	62.2	1.082	1 952	1.47
D 154 ...	13.9	67.0	1.074	1 839	1.45
Bourbon ...	11.2	68.7	1.0793	1.865	1.36
D 139 ...	12 2	67.3	1.0715	1.694	1.30
D 338 ...	7.0	71.0	1.0735	1.806	.83

Of more direct interest to planters are the relative yields of the varieties under what may be considered as normal nitrogenous manuring for British Guiana—300 lbs. of sulphate of ammonia per acre :—

VARIETIES : YIELDS, SACCHAROSE IN JUICE.

Normal Manuring.

Variety	*Tons Canes per acre.*	*Saccharose in Juice. Tons per acre.*
D 721	38.4	4.64
D 118	25.7	3.18
D 625	28.1	3 30
D 167	25.8	2 98
D 317	28 1	3.12
D 651	25.0	3.08
D 246	24.0	3.00
D 44	27.6	2.92
D 490	24.5	2 81
D 4397	26.5	2 80
D 612	21.7	2.74
D 420	23.9	2.65
D 398	21.8	2.37
D 433	22 5	2 37
D 638	19.0	2 33
D 335	19.7	2.31
D 305	20 7	2.17
D 4399	21.9	2.16
D 426	20.4	2.14
D 333	17.0	2 08
D 405	21.5	2 00
D 449	14.3	1.63
D 454	14 2	1.63
D 154	15.7	1 57
D 139	14.2	1 49
Bourbon	12.4	1.47
D 145	12.7	1.42
D 338	8.2	.94

D 118 as in 1910, 1911 and 1912 gave satisfactory results. On the soil of the Experimental fields it is a cane of high resistant power to drought resembling in this respect D 145.

As in 1910, 1911 and 1912, the results of growing D 625 under identical conditions of manuring in rows six feet and five feet apart respectively, were of interest. The mean results were :—

6 feet rows	...	...	24.0 tons of canes per acre
5 feet rows	...	...	25.7 tons of canes per acre.

The mean yield on the 6 feet row during the four corps was 24.0, on the 5 feet rows 27.8 tons of canes per acre ; it is thus clearly advisable on the heavy soil of the Experimental cane-fields to plant sugar-canes in rows five feet apart rather than 6 feet.

AVERAGE YIELDS 1910-1913.

The following shows the average annual yields of the expressed juices of the varieties in tons of saccharose per acre under normal manuring and as mean results of various manurings during the four years 1910 to 1913 :—

		TONS OF SACCHAROSE PER ACRE.	
Varieties.	*Parent.*	*Normal Manuring Yields.*	*Mean Yields.*
D 118	D 625	3.89	3.69
D 625	Dyer	3.32	2.98
D 721	Bourbon	3 21	2.69
D 419	D 625	3 12	2.66
D 167	D 625	3.03	2.45
D 612	Bourbon	2 82	2.41
D 651	,,	2.76	2.27
D 317	,,	2.56	2.35
D 44	D 625	2.41	1.98
D 145	Red ribbon	2.36	2.44
D 398	D 95	2.24	1.87
Bourbon	..	2.20	1.99
D 338	Bourbon	2.15	1.81
D 420	D 625	2.11	2.29
D 405	,,	2.14	1.96
D 638	Bourbon	2.14	1.73
D 4397	,,	2.07	1.64
D 333	D 625	2.06	1.13
D 433	D 1087	1.92	1.84

D 118, D 721, D 419, D 167, D 642, D 651 and D 317 appear worthy of extended trials on the large scale.

D 721, a cane which we considered originally to be of high promise but which for many years gave unsatisfactory yields, has during the past four crops regained the place it formerly held in our estimation.

EFFECTS OF MANURING.

NITROGENOUS MANURES.

The beneficial effects of these manures were, as always, clearly apparent with all the varieties under trial. The mean

returns on 39 varieties as ratoon canes with normal and high manurings—300 and 450 lbs. of Sulphate of Ammonia per acre respectively—were as follows :—

TONS OF CANES PER ACRE.

Fields.	*No Nitrogen.*	*Normal. Nitrogen (60 lbs.)*	*High. Nitrogen (90 lbs.)*
North West ...	12.7 ...	23.4 ...	...
South	8.8 ...	14.3 ...	19.0
North East ...	13.4 ...	23.8 ..	26.7
Mean of South and North East Fields	11.1 ...	19.0 ...	22.5

The meteorological conditions during the year enabled the sugar-canes to make satisfactory use of the nitrogenous manures.

In 1912 on the South and North East fields with ratoon canes 60 lbs of nitrogen produced 5.7 tons of sugar-cane whilst 30 lbs. more nitrogen only caused an addition of 1.5 tons ; in 1913, 60 lbs. of nitrogen produced 7.9 tons of sugar-canes whilst 30 lbs. more nitrogen produced an increased yield of 3.5 tons.

VARIOUS SOURCES OF NITROGEN.

The comparison of the action of nitrate of soda and of sulphate of ammonia applied in equivalent proportions of nitrogen—60 lbs. per acre —gave the following mean results :-

TONS OF CANES PER ACRE.

Fields.	*No Nitrogen.*	*Nitrate of Soda.*	*Sulphate of Ammonia.*
South	8.8 ...	15.5 ...	15.7
North East ...	12.6 ...	18.2 .	24.1
North West ...	12.8 ...	17.1 ...	22.8
Means	11.4 ...	16.9 ...	20 9

As usually has been the case, the value of the nitrogen in nitrate of soda proved lower than that in sulphate of ammonia. This, doubtless, is due to the heavy rainfalls soon after the application of the manures. The opposite was the case in 1912 when owing to the meteorological conditions the nitrogen of nitrate of soda proved to be more effective as a manure than did that of sulphate of ammonia.

The comparisons on South field as to the relative action of nitrate of soda and of sulphate of ammonia in soils for some years continuously manured with these substances were as follows .—

	TONS OF CANES PER ACRE.		
	After Nitrate of Soda		*After Sulphate of Ammonia.*
Nitrate of Soda	14 4	...	16.5
Sulphate of Ammonia	14.4	. .	16 1
	14.4	...	16.3

Comparisons of sulphate of ammonia, nitrate of soda, .nitrate of lime and nitrolim (calcium cyanamide) as sources of nitrogen when applied in repeated dressings and in proportions in each equivalent to 60 lbs. of nitrogen per acre, were made on the North-west field.

As a check on earlier trials the plots which had been continuously manured with the various nitrogenous manures were left unmanured whilst to the respective formerly non-manured plots the nitrogenous manures were applied. The results were as follows :—

(*a.*) Comparisons of sulphate of ammonia, nitrate of lime and nitrolim; mean results with 16 varieties of canes each in duplicate and triplicate plots :—

TONS OF CANES PER ACRE.

No Nitrogen.	*Sulphate of Ammonia.*	*Nitrate of Lime.*	*Nitrolim.*
12.4	23.1	22.5	22.6

(*b.*) Comparisons of sulphate of ammonia, nitrate of lime, nitrolim and nitrate of soda; mean results with 8 varieties of canes each in duplicate and triplicate plots :—

TONS.OF CANES PER ACRE.

No Nitrogen.	*Sulphate of Ammonia.*	*Nitrate of Lime*	*Nitrolim.*	*Nitrate of Soda.*
12.9	23.5	23.2	23.8	18 0

These results generally confirm those of earlier years.

The comparative trials have been made during four years, in two of which the meteorological conditions were very unfavourable to the action of nitrates. The mean results in

the four years during which the trials have been carried out have been as follows :—

1ST SERIES. 16 VARIETIES.

No Nitrogen.	*Sulphate of Ammonia.*	*Nitrate of Lime.*	*Nitrolim.*
15.9	25.4	22.7	22 2

2ND SERIES. 8 VARIETIES.

No Nitrogen.	*Sulphate of Ammonia.*	*Nitrate of Lime.*	*Nitrolim.*	*Nitrate of Soda.*
15.9	25.2	22 5	21.1	19.0

The mean annual increases by the use of 60 lbs. of nitrogen in the various forms have been as follows :—

Sulphate of Ammonia	...	9.4 tons of Canes per acre.
Nitrate of Lime ...	...	6.7 ,,
Nitrolim... ..	.	5.9 ,,
Nitrate of Soda .	...	4 0 ,,

The soil on which these trials have been made is the heaviest clay soil there is in the Experimental fields. It is clear that on such exceptionally heavy soils sulphate of ammonia is far more efficacious as a source of nitrogen than either nitrate of lime or nitrolim, whilst nitrate of soda is by far the least efficacious.

Dried blood was also tried during two crops (none was available for the other crops). Its results in comparison with the more active forms of nitrogenous manures were far from satisfactory.

NITROGEN WITH POTASH AND PHOSPHATES.

Data have accumulat d of recent years pointing to a possibly injurious action of the soluble salts in manures repeatedly applied to cane cultivation on heavy clay soils. The following mean results of trials of sulphate of ammonia without and with sulphate of potash and superphosphates of lime are of interest :—

	TONS OF CANES PER ACRE.			
		Sulphate of Ammonia.		
	No Nitrogen.	*200 lbs.*	*400 lbs.*	*500 lbs.*
Without potash and superphosphates ...	7·9	13·5	19·0	20·2
With potash and superphosphates ...	9·8	14·5	18·1	19 9

The gains indicated to be due to the nitrogenous manurings are :—

	TONS OF CANES PER ACRE.		
	200 lbs.	*400 lbs.*	*500 lbs.*
Without potash and superphosphates	5·6	11·1	12 3
With potash and superphosphates	1 7	8 3	10·1

The results are in accordance with those of former normal years and are the reverse of those obtained in the year of abnormal drought and concomitant short period of growth, 1911-1912, when far higher yields were obtained on the plots receiving phosphates and potash salts than on those not so treated.

EFFECTS OF MANURING WITH PHOSPHATES.

A large number—upwards of 110—of comparative trials with 17 varieties of sugar-cane with and without Superphosphate of Lime were made. In the majority of those trials increases ensued on the application of phosphates. The mean results are as follows :—

NORTH-EAST FIELD.	TONS OF CANES PER ACRE.	
1st Series 16 Varieties.	*No Phosphates.*	*Superphosphates.*
Plots without nitrogen	12·2	13·2
Plots with nitrogen ..	22·5	23·0

N. E. FIELD.			
2nd Series. 6 Varieties.	*No Phosphates*	*Super-Phosphates.*	*Slag Phosphates.*
Plots without nitrogen ...	11·0	13·6	16·4
Plots with nitrogen ...	22·6	23·2	23·8

Numerically the results of applications of phosphates to the varieties used were as follows :—

	No. of Varieties giving	
	Increased Returns.	*No Increase.*
Superphosphate of lime ...	12	6
Slag phosphates	4	2

In 116 plots without and with sulphate of ammonia the following accrued :—

	Numbers of Plots. Manured with Superphosphates of Lime. Increased Returns	No Increase.
Without sulphate of ammonia	19 ...	15
With sulphate of ammonia . ..	34 ...	24
Total ...	53 ...	39
	Manured with Slag Phosphates	
Without sulphate of ammonia	6 ...	2
With sulphate of ammonia	12 ...	4
Total ...	18 ...	6

The results of the trials show that the addition of phosphates to manurings produced increases, but these increases were not remunerative

THE SUGAR CONTENT OF THE JUICES OF VARIETIES OF SUGAR-CANES AND OF NEW KINDS RAISED FROM THEM.

The following shows the mean content of saccharose in the juices of the Bourbon canes and of 9 varieties raised from its seed, determined in 1911 1912 and 1913 in the large field experiment :- -

SUGAR CONTENT OF THE JUICES OF THE BOURBON AND ITS SEEDLINGS.

	Saccharose : Lbs. per Gallon. 1911.	1912.	1913.	*Mean.* 1911–1913.
Bourbon ...	1·854	1·694	1·865	1·804
D 383 ...	1·856	1·614	1·806	1 759
D 651 ...	1·901	1·542	1 884	1·776
D 642 ...	1 784	1·520	1·778	1 694
D 305 ...	1·792	1·506	1 689	1·696
D 4399 . .	1·708	1·486	1·704	1·633
D 638 ..	1·856	1·337	1·634	1·609
D 721 ...	1·712	1·461	1·793	1·656
D 317 ...	1 700	1·464	1·792	1·652
D 4397 ...	1·520	1·269	1·642	1·477

In 1913, one of the seedling varieties yielded juices distinctly richer in saccharose than was that of the Bourbon, whilst the juices of the remainder were lower in saccharose than was that of the parent kind.

During the three years, 1911-1913, in no case has the average saccharine strength of a Bourbon seedling been equal to that of its parent variety

In the case of D 625 and varieties obtained from its seed, the results were :—

RELATIVE CONTENTS OF D 625 AND ITS SEEDLINGS.

		Saccharose : Lbs per Gallon.			*Mean.*
		1911	*1912.*	*1913.*	*1911–1913.*
D 625	...	1.735	1.492	1.754	1.660
D 419	...	1.913	1.668	1.805	1.795
D 118	...	1.855	1.698	1.986	1.846
D 167	..	1.851	1.584	1.834	1 757
D 333	...	1.833	1.525	1.848	1.735
D 420	..	1.709	1.553	1.775	1.679
D 44	.	1.765	1.451	1.728	1.653
D 335	...	1.577	1.552	1.754	1.627
D 405	...	1.662	1.414	1.676	1.584

Here the juices of five of the seedling varieties were richer in saccharose than was the juice of the parent cane D 625, one was nearly similar in strength whilst two were lower.

During the three years, 1911-1913, the average saccharose strengths of four varieties have been higher than that of D 625 two were very similar whilst two were lower.

EFFECTS OF APPLICATION OF MOLASSES TO THE SOIL.

The details of these trials in 1911 and 1912, are given on pages 222-224 of Vol V for 1912, and pages 123 to 125 of Vol. VI for 1913 of *The Journal.* The results have been negative, the apparent increases, when any, that might have been due to the action of the molasses in the soil being within the limit of the probable errors of the trials.

It has been held that although no beneficial effects were apparent during the years of application of the molasses, if the molasses exerted any favourable effects on the microflora of the soil the results of these would be apparent in later crops.

The trials were therefore extended over the crop of 1913, no addition of molasses being made.

The mean results of the 42 plots in duplicate not cross-dressed and cross-dressed with molasses were as follows :—

		TONS OF CANES PER ACRE.	
		Yields.	*Probable Error: Excess or Deficit.*
Without Molasses	...	15·1	·5
With Molasses	...	13·8	5

The results do not in any way support the view that molasses exerts an action on crops posterior to those to which it was applied.

From the numerous analyses which have been made of the soil of this field it is estimated to contain 83,900 lbs. of organic matters in the soil of one acre to the depth of eight inches. Two applications of molasses might have increased this amount of organic matter by the following quantities :—

Molasses added.		*Lbs. of Organic Matter added.*
100 gallons each application ..	...	1,970
200 ,, ,, ,, .	..	3,940
300 ,, ,, ,, .	.	5,910

or to the extent of 2·3 4 7 and 7 per cent. respectively. Our earlier enquiries as to the effect of the varying proportions of humus in the soil of the experimental fields do not tend to our attaching any importance to these small increments.

As in the preceding years the yields on the plots which did not receive any application of nitrogenous manure were apparently reduced by the r sidues of the molasses applications, those not treated with molasses yielding 9·7 tons of canes per acre, whilst those so-dressed yielded 8·7 tons. That is, the crops on the plots which had received molasses were 89·7 per cent. of those on the not-treated plots.

On 27 duplicate plots manured with sulphate of ammonia the mean yields were 16·6 tons of canes per acre on the plots which had not been treated with molasses as compared with 15.8 tons on plots so dressed the yield on the treated plots being 95·2 per cent. of those of the former.

On six duplicate plots using nitrate of soda as the nitrogenous manure, the molasses-treated plots yielded 14·5 tons of

canes per acre as compared with 16·5 from the not-treated plots equivalent to 87·9 per cent. of the latter.

During the three years over which the trials have extended, the plots treated with molasses have given mean annual yields of 19 tons of canes per acre, whilst those dressed with molasses yielded 18·9 tons. These yields are practically identical and are almost as closely concordant as were the mean results recorded from the plots in 1910 previous to the installation of the trials.

The following shows the yields on the molasses-treated plots during the trials, the yields of the non-treated plots being taken as 100 :—

	1911.	*1912.*	*1913.*	*Mean. 1911–1913.*
No manure	82 2	83·1	85·7	83·7
Phosphates and potash ..	92 9	104·7	91 2	96·3
Sulphate of ammonia ...	111·9	95·9	95·5	101·1
Phosphates, potash and sulphate of ammonia ...	100·0	99 2	94·4	97·9
Phosphates, potash and nitrate of soda ...	101·4	103·2	87·9	97·5

During the trials molasses was applied at three different rates. The following shows the results from the treated plots, those from the corresponding non-treated ones being taken as 100 :—

DIFFERENT QUANTITIES OF MOLASSES PER ACRE.

	1911	*1912.*	*1913.*	*Mean. 1911–1913.*
No molasses...	100	100	100	
100 gallons	101·3	98·4	95·5	98·4 ± 1·2
200 „ .. .	96·3	106·8	98·8	101·6 ± 1·4
300 „	110·8	97·8	86·3	98·3 ± 1·4

During the three years, trials have been made with molasses on plant-canes, 1st ratoon canes and 2nd ratoon canes; whilst the residual action, if any, of the molasses has been determined on 1st and 3rd ratoons. The results referred to the yields of the non-treated plots taken as 100 are as follows :—

Direct Application.

Plant canes	100.8
1st ratoons	103·3
2nd ratoons	107·6

After Effects.

1st ratoons	... ...	91·2
2nd ratoons	.. ...	91·1

It is evident that on the heavy clay soil of the Experimental fields—a soil containing a sufficiency of readily soluble phosphoric acid and potash for the needs of the sugar-cane and an ample supply of humus constituents—its sole deficiency from a manurial point of view being nitrogen—the application of molasses is of no practical value, and that in the few cases where its application has been followed by some increase in yield, this may have been due to the small quantities of nitrogen supplied in the molasses. It is economically and agriculturally unsound to supply the soil with from 1,720 to 5,160 lbs. of sugars per acre and not get any increased yield of sugar from the applications

The results are applicable only to such heavy clay soils as are those of the Experimental fields and may not apply to ligter lands.

TRIALS WITH CHLORINATED LIME.

In 1912, trials were instituted of the partial sterilization of the soil by means of a weak solution of chlorinated lime (bleaching powder) The details of the application were given on pages 125 and 125 of Vol. VI of *The Journal* for 1913. The crops of 1912 showed no appreciable effects from the partial sterilization but it was possible that such an effect might become noticeable on the subsequent crop. The results of the 1913 trials did not support this, as the treated plots yielded a lower return of sugar-canes than did the non-sterilized. The results of the trials are shown in the following :—

	TONS OF CANES PER ACRE.	
	Not Sterilized.	*Partially Sterilized.*
1912	22·9	23·0
1913	12 0	11·2
	17·45	17·1

Hence no advantage accrued by the partial sterilization by means of chlorinated lime of this very heavy sugar-cane soil.

Areas under Experimental Cultivation.

THE following statement shows the areas under experimental cultivation with various products at the Experimental Fields and Botanic Gardens, Georgetown: Onderneeming Farm, Essequebo: Marlborough, Pomeroon River; Issorora, North Western District; Christianburg, Demerara River; and Clonbrook, East Coast, Demerara.

Products.	*Acreage.*	*Products.*	*Acreage.*
Rubber, Para ...	99	Balata	6
„ Sapium ...	2	Fruit Trees	4½
„ Other sorts	1	Oil Palm . . .	3
Limes	32	Castor Oil	1½
Coconuts	30	Tonka Beans	1½
Coffee	23	Bananas	1
Sugar Cane ...	20	Cotton, Sisal, Ginger Lilies, Carludovica, etc.	1
Cacao	19		
Rice	7	Ground Provisions (various)	5 to 10

Ostrich Feathers.

There is one article which is outside the usual trade categories but lately made the greatest advance in price of all products though it has since fallen. This is the ostrich feather. The production is far from being equal to the demand. The market for it is held in London once a month; there are very few brokers and prices depend so much on the Cape supply that other sources hardly count The South African trade is well organised and in this respect commands a great advantage over other comers. A very likely place to profit by the situation is British East Africa, where the birds are of very fine quality. A start has been made in New South Wales. A bird, worth about one pound at birth, begins to lay at three years of age and yield about 60 eggs a year. The feathers are taken from the age of nine months, and the old plucking has mostly been displaced by a cutting near the skin which causes no pain. Hot, dry land is necessary, but green food must be supplied, and this combination of requirements calls for careful selection

—Colonial Office Journal, June, 1914.

Leaf Diseases of Hevea brasiliensis.

By T. Petch, B.A., B.Sc., Government Mycologist, Ceylon.

In the Eastern Tropics, the leaf diseases which have been recorded for *Hevea brasiliensis* have been confined to nursery plants and have not caused serious damage In South America, however, there would appear, from the accounts of different investigators, to be at least one which is more dangerous than those known in the East in that it attacks both old trees and nursery plants

The fungus which causes the diseases was first described by Hennings in 1904 under the name of *Dothidella Ulei.* The specimens had been collected by Ule in the Upper Amazon Valley, Jurua (Acre Territory), on the banks of the Rio Jurua, Mirum (Acre Territory), and on the banks of the Amazon in the neighbourhood of Iquitos (Peru) Hennings did not give an account of the injuries caused by the fungus Dr Huber, however, on the occasion of his visit to Ceylon, stated that it sometimes caused serious damage and defoliated the trees

Recently, the fungus has been re-described by Griffon and Maublanc, from specimens obtained on nursery plants at Belem These authors do not consider that it is likely to cause a serious disease. They state that on old trees the injury is doubtless insignificant, and only nursery plants could be seriously injured. Griffon and Maublanc found, on the same leaves as the *Dothidella*, conidia and pycnidia which they regard as stages of that fungus, a discovery which gives occasion for a revision of the known facts relating to the leaf diseases of Hevea in South America.

"KUYPER'S DISEASE."

In 1911, Dr. J. Kuyper described what was considered a different leaf disease of Hevea from Surinam. This disease occurs in three forms In the first stage, the young leaves, only three to five days old, exhibit sub-transparent, olive green or dark green patches, which are sometimes so numerous that the whole leaf blackens and collapses. In the nurseries, sometimes, every plant is attacked. Hevea leaves grow rapidly and apparently the fungus cannot attack the older tissues Consequently the disease is, in many cases limited to the original spots, the centres of which turn yellow and fall out, so that the leaf becomes perforated. At the edges of the holes, small black bodies are produced, often in such numbers that they

form a closed ring. This perforation of the leaf is Kuyper's second form. The fungus can also occur on the leaf stalks and stems, where it produces swollen areas which may form canker-like patches; this is the third form.

The fungus of the Surinam disease was described as a *Fusicladium* and was named *Fusicladium macrosporum* Kuyper. It occurs on both *Hevea brasiliensis* and *H. guyanensis*. Kuyper states that nursery plants are often strongly attacked. Its occurrence is irregular, and that, he considers, may be accounted for by the fact that Hevea drops its leaves twice a year. After the leaf-fall. trees previously seriously attacked often produced sound shoots. For that reason, the injury resulting is small. Weak plants often die, and even six-year-old trees may succumb to repeated attacks. Kuyper advises that old trees which are repeatedly attacked should be removed, that plants which show the second stage should be sprayed with Bordeaux mixture to kill the spores which appear. then, and that, in nurseries, upper parts of stems which bear the third stage should be cut off.

From a comparison of Kuyper's description and figures with those of Griffon and Maublanc, it would appear that these authors are dealing with the same fungus. The pycnidia and pycnospores described by Griffon and Maublanc are indentical with those described by Kuyper as occurring with his *Fusicladium*, while the conidia of the former authors agree with the *Fusicladium* spores of Kuyper. An exact comparison cannot be made as several essential details are omitted from the descriptions, but the coincidences are so close that there does not seem to be much room for doubt.

More recently, Bancroft has recorded another leaf-disease, from British Guiana. The symptoms were "a spotting of the leaves, followed by an increase in the size of the spots, with the production of dried areas which eventually fall away from the green parts leaving holes in the leaf surface." The disease is said to have been "not particularly abundant."

Specimens of the fungus were forwarded to Kew, where it was considered to be new species, and named *Passalora heveae* Mass. The description of the fungus is not available, but it may be pointed out that *Passalora* is a genus closely resembling *Fusicladium* and only doubtfully distinct from the latter. It would appear probable, therefore, that the British Guiana leaf disease is the same as those of Brazil and Surinam.

—The Tropical Agriculturist, April, 1914.

Meeting of the Board of Agriculture.

A MEETING of the Board of Agriculture was held on May 12th, 1914. His Excellency the Governor, Sir Walter Egerton, K.C.M.G, presiding. There were also present Professor J. B. Harrison, C.M.G., Chairman, the Hon C. Clementi, M.A., F.R.G.S., (Government Secretary), Mr. C. K Bancroft, M.A., F.L.S., (Deputy Chairman), Col G. C. de Rinzy, Dr. E. P Minett, D.P.H., Hon. F Fowler, and Messrs. J. J. Quelch, B.Sc., C. Shankland, Wm. Hodgson, H. L. Humphrys, J. Junor, T. Earle, J. F. Waby, W M. Payne, A. Seton-Milne, M.R.C.V.S., (acting Government Veterinary Surgeon), R. Ward, W. E. Augustus, and E S. Christiani, (Secretary.)

The Chairman announced the appointment of the Hon. C. Clementi, Dr. E. P. Minett, Col. de Rinzy and Mr. J. F. Waby, as members of the Board. He also announced that leave of absence had been granted to Mr. G E. Bodkin, Government Economic Biologist (who during his absence would represent the Board and the Colony at the Congress of Tropical Agriculture to be held in London) and to Mr. W M. B. Shields. The Hon. J. Downer had returned from leave.

AGRICULTURAL CENSUS.

Professor Harrison laid over the following report on the census taken of agricultural products for 1913-14 :—

Rice,	1912-13, 41,924 acres;	1913 14, 33,889 acres	decrease	8,035 acres.
Coconuts,	,, ,, 13,698 ,,	,, ,, 14,177 ,,	increase	479 ,,
Cacao,	,, ,, 1,983 ,,	,, ,, 1,863 ,,	decrease	120
Coffee,	,, ,, 2,896 ,,	,, ,, 3,166 ,,	increase	270 ,,
Rubber,	,, ,, 3,139 ,,	,, ,, 4,018 ,,	,,	859 ,,
Limes,	,, ,, 739 ,,	,, ,, 941 ,,	,,	202 ,,
Sisal,	,, ,, 250 ,,	,, ,, 250 ,,		
Maize, Ground Provisions, etc.	,, ,, 18,623 ,,	,, ,, 17,580 ,,	decrease	1,043
Horses,	,, ,, 1,047	,, ,, 964		83
Mules,	,, ,, 1,741	,, ,, 1,778	increase	37
Donkeys,	,, ,, 5,777	,, ,, 6,064		287
* Cattle,	,, ,, 66,086	,, ,, 72,237		6,151
Buffaloes,	,, ,, 64	,, ,, 74		10
Sheep,	,, ,, 16,438	,, ,, 18,408		1,970
Goats,	,, ,, 11,747	,, ,, 14,031		2,284
Swine,	,, ,, 14,116	,, ,, 13,942	decrease	174

* Exclusive of the cattle on the hinterland savannahs; which is estimated at 9,000 head.

CULTIVATION OF PARA RUBBER.

His Excellency said that since Mr. Bancroft had arrived he had done what he expected he would do. His reports proved that Para rubber would grow as well here as it did in the Malay Peninsula and Eastern countries and its growth had so far proved a great success.

COCONUT PALM PEST.

Professor Harrison said Mr. Bodkin had compiled a very useful note on the "Control of the Coconut Palm Pest." In Georgetown it had been recurrent for the last twenty years

His Excellency remarked that so far as he could see not a single occupier had taken the trouble to prevent the spread of this pest of coconut trees.

GRANTS-IN-AID TO VILLAGE SHOWS.

Professor Harrison reported that applications had been received from the West Bank Farmers' Association and the Victoria-Belfield Agricultural Society for grants-in-aid of agricultural shows this year. Mr. Payne had asked certain questions which had been answered

Mr Payne having stated that in his opinion the shows were useless, moved that the amounts applied for be not voted.

Professor Harrison said that he would like to deal with the question of agricultural instruction generally on the East Coast. He had found the district a very expensive one to look after last year they spent $784. He did not quite agree with Mr. Payne that the shows were useless but believed at the same time they could be made far more useful. In order to do that he wanted to modify the system under which they had been working. He would suggest that an Agricultural Officer be stationed at, say, Belfield, and have under his charge a definite area to look after. He thought that if this was done that a marked improvement would result.

Mr. Payne's amendment on being put to the vote, was lost, and the amounts voted.

The proposal to station an Agricultural Instructor on the East Coast was moved by the Chairman, seconded by Mr. Bancroft and adopted.

ONDERNEEMING FARM.

Professor Harrison, referring to a report on the Onderneeming Farm, said that the quarterly returns from September, 1913 to March, 1914, showed a net profit of $1,160.10.

LIVE STOCK SALE.

With reference to the Live Stock Sale, Professor Harrison said that the sale was largely spoilt by the heavy rains. They had the pleasure of selling a large number of very good animals and the net proceeds were $730

"JACK GREATLAND, JNR"

Professor Harrison next announced the arrival of the jack donkey, "Jack Greatland, Jnr." The question as to whether the donkey should be sent out into the country, was referred to the consideration of the Live Stock Committee.

MAL DE CADERAS

Dr. E P Minett and Col. G C. de Rinzy were appointed members of the Veterinary Committee.

Professor Harrison said that the Veterinary Committee had, during the last few months, dealt with a large number of cases of *Mal de caderas*. A large number of orders had been issued and he now laid them before the Board for confirmation. The orders were confirmed.

SWINE PLAGUE AND SWINE FEVER.

Swine Plague and Swine Fever were added to Section 2 of Ordinance 4 of 1892, the Contagious Diseases (Animals) Ordinance

WILD BIRDS.

Professor Harrison reported that permission to export certain specimens had been granted by the Wild Birds Committee to Messrs. H. Y. Delafons.

Micro-Dissections.

An accurate knowledge of the physical state or conditions of living matter has been gained for the first time by the employment of new methods for the dissection of living cells under the highest power of the microscope. Most living matter has been definitely proved to be in the jelly state. In a few kinds of cells the living substance is a liquid. Micro-dissections have thrown new light on the distribution of jellies and liquid in living cells and proved for all time the physical reality of such important structures as chromosomes, nucleoli and spindles. —"Science," June 5, 1914.

Hints, Scientific and Practical.

Partial Sterilization of Soil.

PARTIAL sterilization consists in treating the soil in such a way as to kill some, but not all, of the organisms present, and it is carried out either by heating the soil or by dosing it with mild poison.

The effects of the treatment have been investigated at Rothamsted for some years past, and it has been shown to lead to (1) an increase in the production of ammonia and nitrate, (2) the destruction of many disease organisms and pests, and also of protozoa and organisms detrimental to bacteria, (3) the formation of certain substances not usually present in the soil and (4) a phys'cal improvement in heavy soils. The effect on the plant is therefore to give it a larger supply of nitrogenous food and a healthier medium in which to live; the unusual compou ds also have certain effects on quality which, however, are not always very marked. The practical importance of the treatment is that it acts like a dressing of nitrogenous manure, and also enables the grower to deal with diseased or "sick" soils

--The Journal of the Board of Agriculture (England), May, 1914.

The Sugar Palm.

IN the byways of tropical agriculture there is no more interesting case of neglected possibilities among the major crops than that of the sugar palm *Arenga saccharifera.* This plant, mentioned in Sanskrit writings, is one of the oldest economic species used by civilised man; yet, with the possible exception of a few semi-cultivated plantations in Malaya, there has probably never been a case of using this palm as a major crop under strictly agronomic conditions.

The world has just begun to realize that a deplorable waste of materials in the way of palm sugars has been for a long time a negative fault of modern crop work in the Tropics. India in particular now realizes that very large profits can be made through utilizing the extensive stands and semi-cultivated groves of the wild date (*Phœnix syvestris*) of Bengal, and the palmyra (*Borassus flabelliformis*) of Southern India and Ceylon. In the

Philippines, also, there are four palms capable of greatly increasing the sugar production, though one of these, the coconut is too valuable as a producer of copra, and another, *Nipa fructicans* is likely to be for some time used more as an alcohol crop. The buri (*Corypha elata*) will undoubtedly be held in higher esteem in the future, when the methods of tapping it are better worked out and a way around the difficulty of its late maturity is found.

—The Philippine Agricultural Review, May, 1914

Millepedes and Centipedes.

MILLEPEDES and centipedes are somewhat alike in general form, and since millepedes are distinctly injurious while centipedes are on the whole beneficial, it is necessary to distinguish clearly between them The following points will serve for this purpose Millepedes have *two* pairs of legs to each segment of the body, which (with the exception of the form known as *Polydesmus*) is rounded or cylindrical in form. Centipedes have only *one* pair of legs to each segment of the body, which is somewhat flattened. As regards differences in habit, millepedes are rather sluggish and when disturbed coil themselves up like a watch spring, while centipedes are active and usually escape by running as soon as they are discovered.

Centipedes are carnivorous and feed mainly on small slugs, snails and insects The food of millepedes is almost entirely of a vegetable nature Roots, bulbs and tubers of all kinds are attacked, and when the animals are numerous the resulting damage may be considerable. There is nothing very peculiar in the form of injury produced and the best method of diagnosis is the discovery of the millepedes themselves In the case of *Julus pulchellus* the animals may often be found in a cavity in the root or tuber, which is gradually eaten away; occasionally, however, they seem to attack the cuticle of the root only, and where the damage takes this form, in potatoes, a type of scab is produced which closely resembles that attributed to "mechanical injury" In the case of an attack of the larger species an examination of the soil near the injured plant, or of any rubbish close by, will usually show which species is responsible. It should be noted, however, that in all cases of attack a certain amount of decay is produced which attracts other enemies, and the identity of the original offender may be thus obscured.

In many cases of damage by millepedes which have been brought to the notice of the Board, there is also evidence of bad cultivation; where high cultivation is practised there is much less likelihood of a serious attack.

Care should be exercised in the use of fresh leaf mould and decaying vegetable matter, which frequently contain these pests.

Millepedes may be trapped by placing just under the ground mangolds, beets, or turnips which have had the interior scooped out. The traps must be examined at frequent intervals and the millepedes collected and destroyed.

Millepedes may be poisoned by soaking pieces of potato, mangold, etc., in a strong mixture of Paris green in water. The baits should be placed near the attacked plants and should be covered with a board, stone, or large leaf to prevent them becoming very dry. It should be noted that *baits so treated are poisonous to man* and *animals as well as millepedes.*

Carbon bisulphide injected into the soil is stated to be a certain remedy, but the treatment is expensive and need only be used where the plants attacked are valuable and the area involved small.

Lime, distributed broadcast and dug in, and soot or soot and water, have been found to be partial remedies.

—The Journal of the Board of Agriculture (England), April, 1914.

The Scientific Investigator.

Probably most of the effective scientific investigation is a result of the fact that some student has taken the time to digress from the beaten paths at various points, and finally he came into regions of unexpected fertility. Love of knowledge, not love of renown, is the ideal incentive for investigation. The ideal investigator is not the man who says to himself "I am going to become an investigator" but rather the man who becomes deeply interested in a subject and is unable to find in the literature the things he is anxious to know. He is thus forced by a desire for more knowledge to become an investigator.

—"Science," June 5, 1914.

The Model Gardens.

Record of Attendances.

Below is given a table, arranged in quarterly periods setting out the number of pupils who attended the Model Gardens of the colony from April 1, 1907. These quarters (recorded below as 1st, 2nd, 3rd and 4th) run from January 1 to December 31. The totals only during 1907, 1908, 1909 and 1910 are given; the records since then are in detail.

Quarters.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Houston, E. B.	Wakenaam.	Total Attendances.
1908.										
1st–4th	5,447	3,386	1,477	887	1,053	160	...	...	..	12,410
1909.										
1st–4th	6,473	2,665	1,738	1,277	1,192	1,897	662‖	...	...	16,904
1910.										
1st–4th	5,026	2,297	3,269	2,348	1,151	1,947	1,984	1,532		19,564
1911.										
First	1,086	360	1,042	838	312	514	414	572	577	5,695
Second	1,263	326	713	816	286	292	536	591	688	5,511
Third ¶	1,093	385	910	627	361	297	543	441	639	5,296
Fourth	1,687	448	935	588	447	406	737	957	540	6,745
1912.										
First	1,127	379	1,374	1,034	425	207	573	359	423	5,901
Second	1,385	359	1,096	900	484	553	730	461	413	6,381
Third	1,416	400	763	889	412	572	621	616	443	6,132
Fourth	1,586	254	1,162	479	459	768	620	720	439	6,487
1913.										
First	1,613	464	1,060	637	529	764	661	464	342	6,534
Second	1,273	498	1,368	863	517	766	653	508	401	6,847
Third	1,176	495	904	670	498	945	736	475	333	6,232
Fourth	1,094	505	1,203	349	451	924	518	389	243	5,576
1914.										
First	1,134	481	1,245	624	564	1,014	475	498	370	6,405
Second	1,047	489	1,008	699	322	726	428	425	263	5,407

Note.—The figures for the Country-Model Gardens quoted above refer only to the numbers present during instruction given by the Superintendent Teacher. It has not yet been found feasible to keep reliable, full records of the very numerous attendances during his absence.

¶ Schools in vacation during August

‖ Instruction commenced in July.
§ Instruction commenced in April.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported this year up to June 30, 1914. The corresponding figures for the three previous years are added for convenience of comparison.

Product.	1911.	1912.	1913.	1914.
Sugar, tons ...	30,368	22,337	22,349	32,576
Rum, gallons ..	671,468	1,275,992	1,428,085	1,646,370
Molasses, casks ...	437	906	575	658
Cattle-food, tons ...	2,461	2,417	4,690	1,050
Cacao, cwts. ...	159	102	14	300
Citrate of Lime, cwts.	25·4	0·5	...	21
Coconuts, thousands	472	875	460	1,091
Copra, cwts. ...	746	817	620	820
Coffee, cwts. ...	685	1,147	647	1,756
Rice, tons ...	1,446	2,068	3,338	3,967
Rice-meal, tons ..	491	1,140	1,087	202
Cattle, head ...	472	288	338	623
Hides, No. ...	2,201	1,947	2,421	2,738
Pigs, No. ...	509	629	942	653
Sheep, head ...	21	37	18	12
Balata, cwts. ...	1,670	317	2,300	3,127
Charcoal, bags ...	38,130	37,825	2,8694	36,861
Firewood, Wallaba, etc., tons ...	5,893	5,290	4,312	5,652
Gums, lbs. ...	2,518	2,425	1,515	719
Lumber, feet ...	243,085	99,550	292,233	198,145
Railway Sleepers, No.	2,020	3,876	1,503	2,602
Rubber, cwts. ...	17·3	1·3	·6	6
Shingles, thousands	1,473	819	1,269	1,061
Timber, cubic feet	127,706	142,359	222,929	132,468

JOURNAL

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OF

BRITISH GUIANA.

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An Explanation.

AT the outbreak of the present war, *the Journal of the Board of Agriculture of British Guiana*, in common with many of its contemporaries, had temporarily to suspend publication. The uncertainty of every prospect and the necessity for economy primarily dictated this course; and we believe our many subscribers and readers will agree that although they themselves suffered, perhaps, some little inconvenience, it was unavoidable in the circumstances. It is now possible to resume publication, and with it to offer an explanation of the delay in the appearance of this number, and an apology. In this issue we shall endeavour to resume the line of work previously carried on and to bridge over the long gap since our last number. By the end of the year we hope to have made up our arrears, and, by completing the tale of the missing issues, to give our subscribers full value for their money The agricultural articles by the Director of Science and Agriculture and the Government Botanist will be resumed in our next number, when the first of a new series on the Cultivation of Limes in the Colony will be commenced. Meanwhile the old features of "The Journal" appear, none the worse, we trust for their temporary eclipse.

Practical Education in Practice.

WITHIN the last year, it has become evident that at last something may be done to bring the system of Education in the Colony more into line with the real needs of the people. Broadly speaking, the change adumbrated seems to trend towards giving education a practical bias. Thus it has been proposed that the curriculum at Queen's College shall cease to be primarily classical Within the last twenty-five years, English Public Schools have developed Mathematical and Science sides equal in importance, in many cases, to the Classical section, and even more successful; but Queen's College, owing to lack of funds and the restricted recruiting area for pupils consequent on the limited resources of the Colony, has not been able to make much advance in that direction. With commendable courage the situation has been grasped, and the bold suggestion has been put forward that Queen's shall become, in the near future, a Science School. The change will, we believe, mark an epoch in the history of education in British Guiana.

To the educationalist of the literary type—still the prevailing one—such a transformation will not appeal. To him the study of the Classics is the only true basis of education, and nothing will move him from that position. We would put two suggestions to him one, that it does not follow—granting that the literary man's thesis has been proved correct in Europe—that the classics are indispensable to the more primitive races of a tropical colony; the other, that the arguments in favour of a classical basis are fundamentally those of the wise old College Don, whose three reasons for the study of Greek were (1) that it enables one to read the words of Our Lord in the original, (2) it gives one a proper contempt for those who do not know the language, (3) it throws open to one positions of emolument for which, otherwise, one would not be eligible. But in British Guiana the lack of an education of the literary type is in reality no bar to success in any walk of life. The restrictions which obtain in Europe in this respect are here practically in abeyance; and the intelligent colonist will conclude that if education is to be given the more it leans to the practical side, the better.

There is a prospect, too, that Primary Education will soon share the same practical tendency, and develop on two diverg-

ing lines—Technical and Agricultural And in view of all this we would like to draw attention, with some emphasis, to a point which is apt to be overlooked. Practical education means money. Money for apparatus, money for equipment, money for renewals and supplies. A modern English Public School of the first class, with 350 boys, where the principles of practical education have been grasped and conscientiously put into practice, will spend a *minimum* of $5,000 a year on its Science teaching. *Every* Winter-school for the teaching of Agriculture in Holland is fully equipped with apparatus, models of flowers, (as there is, of course, no fresh material available), detailed drawings of fungus pests, models and skeletons of the different types of cattle and horses, and collections of dried cereals and grasses. Now, all these things cost money—much money. Practical education cannot be given unless it is given practically. The technical pupils must have tools to use—for *each* boy to use—until they learn to use them properly. They must have machines to handle ; they must have instruments. Agricultural students must have ground to till, tools to till it with, seeds and cuttings to plant. Unless all these things are provided, practical education must be a failure. Given them, we may hope to see a return as rich as that the Germans are reaping from their wise building up of a great class of skilled workmen. The Germans, to their credit, have never grudged the spending of money in technical education ; and that—often lavish—expenditure, by creating a demand for instruments of precision and complicated machinery, has reacted to produce a body of highly skilled artisans, who in their turn have been able to cheapen immensely the work of their hands. How great an asset these skilled workmen are proving to their country we are having daily demonstrations.

We are aware that to mention the necessary spending of money is not a popular thing to do at the present juncture. The cry is all for economy. But as judicious expenditure is not always extravagance, so the saving of money is not necessarily the best kind of thrift We have had an example recently The Model Gardens—the result of a scheme suggested in 1903 and most carefully fostered and developed since that date—were summarily abolished by a resolution of the Combined Court in March, 1915. These gardens, which were visited by nearly 22,000 children in 1914, provided the children of Georgetown and New Amsterdam with practically their only opportunities for learning something of the elements of gardening and for

obtaining a liking for such pursuits; they were steadily undermining the prejudices of the children and of their parents against manual labour of the agricultural type; they afforded practical demonstrations of school garden work to the primary schoolmaster and pupil teachers; and the nine of them cost the Colony $2,000 a year. And in half an hour they and the steady work of years were destroyed. The incident does not give much encouragement to the advocates of an enlightened policy of practical education.

A Good and Cheap Whitewash.

The Department of Agriculture of New South Wales recommends the following as a cheap white-wash which will stand the rain and weather without coming off, and will do for galvanised iron:—Place enough tallow required for the purpose in a large bucket; then lay about the same quantity of good lime (dry) on top of the tallow, *i.e.*, equal portions of each; then pour enough water on to slake the lime. When the heat from the lime has melted the tallow, and all is well dissolved, stir it thoroughly until all is well mixed; then apply (warm, if possible) with a large brush. This will do for any surface. The surface must be quite dry before applying the mixture. If required to dry very white, add a small quantity of "blue."

Coconuts and Salt.

The belief that common salt is specially beneficial as a manure for coconuts is not supported by any experiments in the field as far as we are aware. Salt does benefit certain crops; the sodium being able to a limited extent to take the place of potassium especially when there is a deficiency of the latter. It is believed also that salt releases potash in the soil for the use of the plant; but there are, we think no grounds for supposing that coconuts derive particular benefit from salt because of their maritime origin. At Peradeniya the salt plot gave an average of 28·5 nuts per tree in 1913 compared with 28·6 of the potash plot, but it started off with a yield of 54 in 1911; thus declining 47 per cent. The potash plot on the other hand rose from 24·7 to 28·6, an increase of 16 per cent.

—Tropical Agriculturist.

Para Rubber in British Guiana: 1915.

By C. K. Bancroft, M.A., Assistant Director, Department of Science and Agriculture.

In previous papers relative to the cultivation of Para rubber in the colony the growth of the trees in different localities and the estimated cost per acre of bringing an area of 500 acres into bearing have been dealt with

The latter was shown to be a reasonable amount, under £40 per acre. Recently, other data have come to hand. The experimental tapping, first of 379 trees five-and-a-half years old and later of 300 trees six-and-a-half-years old at Issororo Experiment Station, gives a fair indication of what the cost of collecting the rubber, from trees growing under favourable conditions, will be. The output from 379 trees at Issororo. between November, 1913, and December, 1914, was 597 lbs. of dry rubber, or a little more than 1½ lbs. per tree per annum. The cost of collecting was 16 cents per lb. dry. In the more recent experiment which is now in progress, the output from 300 of these trees from February, 1915, to May, 1915, has been equivalent to 240 lbs. dry The trees are therefore yielding at the rate of about 2½ lbs. each per annum. The rubber from these latter trees is collected by one man and one boy working each one-third of a day. The cost of collecting is averaging 7 cents per lb. of dry rubber.

These experiments are on a small scale; but they afford a fair indication that under proper estate conditions it will be possible to collect at a cost which will allow of a fair margin of profit with Plantation Para Rubber selling on the market at 48 cents per lb.

At Christianburg Experiment Station, on the Demerara River, 250 trees six years old, have recently been included in one experiment. About 112 lbs. of dry rubber have been collected.

THE PROFIT PER ACRE.

The yields obtained from trees growing in various parts of the colony indicate that 300 lbs. of dry rubber per acre can be counted as the return from trees growing on suitable land in a large area in full bearing. This output per acre would therefore, at an average market price of 48 cents per

lb., realise $144 per annum. With a cost of tapping and collecting of, say, 15* cents per lb., the total cost of collecting the output per acre would be $45; and if other charges, *viz.*, management, upkeep, curing, transport, shipping, commissions, &c., amount to an equivalent sum,† the total cost of placing the output per acre on the market would be $90. This would allow of a profit of $54, or £11 5 0 per acre.

Reference has been made above to the conduct of the cultivation under proper estate conditions. By this it is meant that the estate should be laid out in blocks (50 acres is a convenient size for a block), each being under the charge of a driver or foreman who would superintend the tapping, weeding, &c., of the block. Ranges should be in convenient parts of the estate so as to allow labourers to get to work early in the morning. Houses for coagulating the latex should also be placed in different sections of the estate so that the latex may be coagulated before being brought to the factory for rolling, curing, &c.

THE LABOUR FORCE REQUIRED.

One man would be required to tap and collect the latex from at least 300 trees, each having two cuts, before breakfast-time (11 a.m.) To tap the trees on a large rubber estate requires a permanent labour force of about one labourer to three acres. When the estate is in full bearing little attention need be paid to upkeep, since there is little or no weeding to be done; and as the tapping and collecting occupies only half-a-day's work, in order to ensure an adequate supply of regular labour it may be advisable to give out, free of rent or on easy terms, cultivation plots adjacent to the lines.

There are three primary factors in the cultivation of Para Rubber: first the rate of growth of the tree, second the yield of the tree and third the cost of production. In respect to these there is reason to believe—so far as the data at our disposal are concerned—that, providing sufficient labour is available for tapping, the cultivation of this product in the colony should prove successful.

* This figure is arrived at from consideration of the average output per tree growing in different parts of the colony under favourable conditions and of the number of trees which one man is able to tap in one day.

† On the Eastern plantations it is generally reckoned that the cost of tapping and collecting the rubber is one-half of the total cost of production. In this colony there is every reason to suppose that the same ratio would prevail.

Lessons with Plants in British Guiana.

By the Editor.

"*It is finding answers to questions which chiefly deserves to be called Science.*"—L. C. Miall, F.R.S. in "Teaching and Organisation."

VII.

Readers of "The Journal" will remember that in Vols. V and VI. there appeared a series of articles based on the local Flora, the object being to assist students in their examination of common colony plants and to direct their attention to points of interest or importance from a botanical point of view. Anyone who has attempted to teach "Nature Knowledge" in British Guiana must have been asked by some of his class for a 'text-book' on the subject. Such, at least, has been the experience of the writer: and these articles were written with the idea of meeting that demand. It is the great virtue of Botany as an educational subject in this colony that there is no text-book which can be of any real use to the student; who is perforce thrown back on his own resources and compelled—if he is indeed a student and not a mere candidate for examination—to find out his information for himself. Thus he is introduced to the true method of scientific work, which is essentially heuristic and not a memorising of the results of other folks' labours. At the same time the teacher is well aware that guidance and assistance are very necessary for the student at all times, and especially at the commencement of the subject; and it is hoped that this series of articles will supply this need and so serve the best interests of this department of education. We venture to assert that any one who has conscientiously endeavoured to find out for himself the answers to the questions suggested, and has worked through the specimens dealt with, in detail, will have acquired a facility in observation and a *confidence in his own powers* which will serve him in very good stead—even in the examination room. For examiners, as a class, are improving. It may be mentioned that when the student has acquired at *first hand* the knowledge led up to in these "Lessons" he *will* find an ordinary elementary text-book of Botany some real use to him.

A RECAPITULATION.

As it is some time since the "Lessons with Plants in British Guiana" first appeared in "The Journal" it may not be out of place to recapitulate the chief points touched upon, and to recall to mind the ground covered.

The "Lessons" began with the examination of the Hibiscus; here one of the commonest and most conspicuous of plants; and with the help only of a pair of sharp eyes and a sharp knife the structure of the flower was ascertained and names given to the various parts. Great stress was laid upon the importance of drawing Some idea of the structure of the stem and root were arrived at—a rudimentary idea, it is true, for to see the details required the aid of a microscope—and the importance of *comparing* various plants of the same natural order was clearly brought out. Thus the student was directed to compare the Hibiscus with the Sorrel, the Ochro, the Cotton, the Silk-cotton and the "Jumbi Ochro," and to note their resemblances and their differences in habit, flowers and leaves. The difficulties of classification are always a stumbling-block to the beginner; and the compilers of text-books seldom give their readers any notion of how simple and inevitable a thing it is. They stick to 'types.' The earliest Botanists were just in the position of our beginner: they examined every flower and plant they encountered: and very soon they were struck by the resemblances between certain forms and their differences from others: and so they "classified" them into various groups. It took some hundreds of years to arrive at our present-day (and still very imperfect) classification: and we can save our student much time by directing him to related plants and so enabling him to grasp clearly the idea of classification. Of the precise value of the reasons for the placing of certain plants in certain families, he cannot expect to be a judge at this early stage of his studies.

MECHANISM IN THE FLOWER.

Having noted the difference between the "herbaceous" stem of the ochro and the "woody" branches of the Hibiscus, we passed on to consider the Flamboyant tree, which is so brilliant an ornament of the streets of Georgetown during the rainy season. We dissected the flower and came upon the idea of a *mechanism* in the flower; some arrangement of its parts which facilitates or ensures more certainly the phenomenon of

pollination—the first step towards the setting of seed. Hints were given to study the correlation of the structure of the flower with the visits of birds and insects, and some examples of such observations and how to record them were given. Some related plants were studied—the Barbados Pride, the Bauhinia—and the idea of a *suppression* of parts of the flower was arrived at. Such modifications are a great source of trouble to a beginner, and it is only by the comparative method of examination that familiarity with the phenomenon and an understanding of it can be gained. In this respect it was pointed out that a study of the Tamarind, the Carrion Crow Bush and the common Cassias was particularly instructive. The three great divisions of the Natural Order *Leguminosae* were hinted at—they will be dealt with more fully later on—and we passed on to a consideration of the "Baby Cucumber," a pretty but pernicious weed, which led us incidentally to the subjects of tendrils and *homology*, and to the notion of "*diclinous* flowers" and "*dioecious* plants." As a family characterised very emphatically by these features, we dealt briefly with some of the commoner members of the N.O. *Euphorbiaceae*, so important in this Colony, and arrived at the conclusion that suppression of the parts of the flower might go so far as to leave the essential organs practically naked. In the sixth article we came to the *Compositae*, the most successful of all flower types. An examination of the sunflower revealed the existence of sterile flowers, specialized with the effect of rendering the great mass of florets forming the 'head' more conspicuous. Attention was drawn to the simplicity but great efficiency of the floral structure—the single ovule in a well-protected ovary; the aggregation of many florets in a head so that one insect can cross-pollinate many flowers and so set a multitude of seeds—but hardly enough stress was laid on the method in which the mechanism works.

THE FLORAL MECHANISM IN THE COMPOSITAE.

If a sunflower be carefully watched, it will be seen that the florets ripen successively from without inwards—*i.e.*, the youngest florets are in the centre of the disc—and that *time* is an important factor in the mechanism. The anthers ripen first and being syngenesious, discharge their pollen into a common 'box' as it were. The style then begins to lengthen and gradually pushes the pollen out of the top of the anther-box. This process may last for 12 hours or more, and during all this time a steady supply of pollen is available for visiting insects to trans-

port to other florets or to other flower-heads. The 'bifid' style, which is covered with hairs on the outside but has the receptive inner surfaces of its two lobes closely adpressed to each other during its action as a piston or brush in the anther-box, now pushes through, the anther filaments wither and pull the anthers back, and the stigmatic lobes curl over and become receptive. Should cross-pollination not occur, the stigmas may bend over so far as to pick up pollen from the hairs on the style below them—pollen from the same flowers, be it noted. Thus fertilization is assured; for even self-fertilization is better than no fertilization at all.

'THE TRIGGER MECHANISM' OF *Thunbergia*

As an example of a more complicated type of mechanism we may quote the *Thunbergia*, a large and beautiful flower, of two varieties, (white and pale blue) which is common as an ornamental creeper in Georgetown and may be seen in exceptional luxuriance on the Orchid House in the Nursery at the Botanic Gardens. Even a casual observation of the plant will reveal the frequent visits of a big blue bee which alights on the lowest petal lobe and eagerly pushes its way into the throat. After a few seconds the insect emerges with the back of its thorax covered with yellow dust. It will be noticed that this dust is on a part of the insect's body from which it cannot be easily removed—for a bee has as much difficulty in scratching its back 'between its shoulders' as a man has. If the student tries probing a freshly opened flower with the pointed end of a lead pencil he will find that he can 'work' the flower almost as well as the bee; and if he dissects the blossom —and includes in his disection a carefully cut longitudinal section—he will disclose its secret. Careful note should be made of the situation of the 'nectar,' secreted in this case by a thick ring of tissue round the base of the ovary—and of the efficient protection afforded to the store. Anything sweet is exceptionally attractive to animals, especially insects; but it would not benefit the flower if small creatures, not adapted to work the mechanism, were free to rob it. That the big blue bee is exceedingly well fitted for the task will become more and more evident as observation proceeds. It has strength to push its head well into the flower and to force its tongue past the guarding fringe of hairs, while its tongue is long enough to reach the pool of nectar stored in the base of the corolla tube. When the bee visits the next flower, the scoop-shaped stigma scrapes off some of the pollen from the back of the

nsect, but renews the supply from its own bursting anthers But none of this is left on the stigma as the bee retreats. Why, will be obvious to the observer.

With these suggestions for an extremely pretty exercise, we leave our readers with the next number of "The Journal," when we hope to deal with some "Monocotyledons."

(*To be Continued*).

Wedge-grafting.

The Superintendent of the Lucknow gardens recommends recourse to wedge-grafting with scions of the female papaw on the male. This is done by removing the young lateral shoots found on the female after the first year,—especially if the tree has had its top removed, and grafting these on young male plants.

It is necessary that the shoots should be about the same size as the stem of the stock.

—The Tropical Agriculturist, March, 1915.

Papain.

In recent years the papaw has come into prominence on account of the drug papain obtained from the fruit. The usual manner of collecting this is by making light superficial incisions or scratches in the unripe fruit while on the trees, using a bone knife or other non-metallic instrument for the purpose; incisions need not be more than about a quarter inch deep and about half inch apart The milky viscid juice immediately exudes from the cuts and is collected in porcelain, enamelled or glass dishes; it coagulates naturally, forming a resinous-looking granular mass, and is then dried in the sun. It must be dried rapidly, otherwise it putrifies and gives off an unpleasant sour odor. To obviate this a trace of formalin should be added to the juice when collected. The tapping, i.e., the process of obtaining the juice by incisions, may be repeated at intervals of two or three days, but unless this is done carefully the fruits are liable to wilt and dry up. The early morning is the best time to tap, the flow being then most abundant.

—Tropical Agriculturist (Ceylon), March, 1915

A Preliminary List of the Mosquitos of British Guiana.

By F. W. Urich, Entomologist, Board of Agriculture, Trinidad.

THE following list of Mosquitos was compiled with the assistance of Mr Frederick Knab when the writer was in Washington in 1911. When not otherwise stated the specimens are represented in the collection of the U.S. National Museum.

Forty species for a country like British Guiana is a very small number indeed and shows that much collecting remains to be done. The object of this small list is to put on record in a local publication the species found in the Colony and to call attention to the work that remains to be done.*

Sub-family *Anophelinae.*

1. *Anopheles argyrotarsis*, Robineau—Desvoidy.
   New Amsterdam (Aiken).
   Range.—Trinidad and Martinique.

2. *Anopheles tarsimaculatus*, Goeldi.
   Berbice (Aiken), Georgetown (Rowland).
   Range.—Trinidad, Grenada, Suriname.
   This is the South America form of *A. albimanus.*

*We welcome Mr. Urich's article as a contribution towards the knowledge of British Guiana Mosquitos because it contains one or two interesting points. Thus the identifications of *Culex quinquefasciatus (fatigans)* with *C. cubensis* and of *Uranotaenia lowii* with *U. minuta* coincide entirely with the results obtained by our local workers and it is good to have such questions definitely settled. *Haemogogus equinus* occurs as the only addition to the list of mosquitos published in local journals. On the other hand Mr. Urich's list omits a great deal—at least 21 authentic species—and it would appear that the considerable amount of research on British Guiana Mosquitos done since the writer was in Washington in 1911 has escaped the notice of our contributor—possibly because the accounts of it have appeared chiefly in local (British Guiana) publications.—ED. J. B. A.

3. *Anopheles nimba.* Theobald.
(*Stethomyia*) Mono. Culicid 111, page 62, 1903).
Guiana.
Not in the collection at Washington.

Sub-family *Culicinae.*

4. *Megarhinus superbus.* Dyar and Knab.
Siparuni Creek, Essequibo River (Wise), Georgetown (Moore).
Range.—Trinidad.

5. *Megarhinus haemorroidalis,* Fabricius.
Omai (Wise), Siparuni Creek (Wise).
Range.—Paramaribo.

6. *Aedeomyia squamipennis.* Arribalzaga.
New Amsterdam (Aiken), Georgetown (Aiken.)
Range.—Dutch Guiana.

7. *Bancroftia fuscipes,* Coquillet.
(Mansonia.)
Omai. (Wise.)
Range.—Trinidad.

8. *Uranotaenia pulcherrima,* Arribalzaga.
Georgetown (Moore).

9. *Uranotaenia lowii.* Theobald.
= *U. minuta.* Theobald.)
Georgetown (Rowland), Berbice (Aiken).
Range.—Trinidad.

10. *Uranotaenia geometrica.* Theobald.
Georgetown, (Rowland).

11. *Pseudouranotaenia rowlandi.* Theobald.
Mono. Culicid IV, page 566, 1907.
New Amsterdam.
Not in the collection at Washington.

12. *Anisocheleomyia leucoptera.* Theobald.
Mono. Culicid IV, page 575, 1907.
British Guiana.
Not in the collection at Washington.

13. *Psorophora scintillans.* Walker.
(*P. iracunda.* Dyar and Knab.)
Siparuni River (Wise).

14. *Janthinosoma posticatus.* Wiedemann.
(J. coquillettii. Theobald).
New Amsterdam (Aiken), Berbice (Aiken), Georgetown (Rowland).
Range.—Trinidad and Suriname.

15. *Janthinosoma lutzii,* Theobald.
Rupununi (Wise).
Range.—Trinidad.

16. *Taeniorhynchus confinnis,* Theobald, not Arribalzaga.
(*J. indoctum.* Dyar and Knab.)
British Guiana.
Range.—Trinidad.

17. *Aedes scapularis,* Rondani.
= *confirmatus,* Arribalzaga.
Berbice (Akien), Georgetown (Rowland).

18. *Aedes serratus.* Theobald.
Berbice (Aiken), Georgetown (Rowland).

19. *Aedes taeniorhynchus.* Wiedemann.
Corentyne Coast (Aiken), Berbice (Aiken).

20. *Aedes nubilis.* Theobald.
Rupununi (Wise.)
Range.—Trinidad.

21. *Aedes calopus.* Meigen.
Commonly called "The Stegomyia."
Georgetown (Rowland).

Range.—Trinidad, Dominica, Martinique, St. Thomas, Paramaribo, &c.

22. *Haemagogus equinus.* Theobald.

H. affirmatus. Dyar and Knab. *H. philosophicus.* Dyar and Knab.

Schepmoed (Rowland).

Range.—Tobago.

23. *Mansonia titillans.* Walker.

Georgetown (Moore), New Amsterdam (Aiken), Berbice Aiken).

Range.—Suriname, Trinidad.

24. *Mansonia fasciolatus.* Arribalzaga.

Schepmoed (Rowland), Berbice (Aiken), Georgetown (Rowland).

Range.—Trinidad.

25 *Culex epirus.* Aiken,

British Guiana Med. Annual, 1908. (separate page 8, 1909).

Not in the collection at Washington.

26. *Culex lateropunctata.* Theobald.

Mono. Culicid. IV, page 458, 1907.

Not in the collection at Washington.

British Guiana.

27. *Culex quinquefasciatus.* Say.

(*C. cubensis, C. fatigans*).

Omai (Wise), New Amsterdam (Aiken), Georgetown (Rowland), Berbice (Aiken).

Range.—Trinidad, St. Vincent, Barbados, Martinique, St. Thomas, Dominica, Guadaloupe.

28. *Culex similis* var. *lachrimans.* Dyar and Knab. = (C. aikeni. Dyar and Knab, not Aiken.)

Berbice (Aiken).

29. *Culex aikeni.* Aiken (not Dyar and Knab.)
=(Gnophodeomyia inormata. Theobald).
Berbice (Aiken).
Sub-family Sabethinae.

30. *Wyeomyia ulocoma.* Theobald.
Mono. Culicid 111, 313, 1903. (Dendromyia) British Guiana.

Not in the collection at Washington.

31. *Wyeomyia luteoventralis.* Theobald.
(*Dendromyia* Mono. Culicid 111, page 318, 1903.)
British Guiana.
Not in the collection at Washington.

32. *Wyeomia quasiluteoventralis.* Theobald.
(Mono. Culicid 111, page 317, 1903.)
British Guiana.
Not in the collection at Washington.

33. *Wyeomyia asullepta,* Theobald.
(Dendromyia) Mono. Culicid, 11 1, page 315, 1903.
British Guiana.
Not in the collection at Washington.

34. *Wyeomyia aporonoma.* Dyar and Knab.
Georgetown (Moore).

35. *Wyeomyia melanocephala.* Dyar and Knab.
Rupununi (Wise).
Range.—Trinidad.

36. *Wyeomyia chresta,* Dyar and Knab.
Georgetown (Moore.)

37. *Limatus durhami.* Theobald.
Rupununi (Wise), Georgetown (Moore).
Range.—Trinidad.

38. *Goeldia fluviatilis,* Theobald.
(Mono. Culicid 111, page 331, 1903).
British Guiana.
Not in the collection at Washington.

39. *Sabethes schausi.* Dyar and Knab.
Omai (Schaus.)

40. *Runchomyia frontosa.* Theobald.
(Mono Culicid 111, page 319, 1903.)
British Guiana.
Not in the collection at Washington.

Coconut Cake and Palmnut Kernel Cake.

Coconut cake and palmnut kernel cake are two feeding stuffs which are being brought prominently to the notice of stock owners as a result of the war. The main reason for this is that part of the large quantity of the raw products from which these cakes are manufactured, *viz.*, "copra" and palmnut kernels respectively, which were formerly exported to Germany and Austria-Hungary, has now been diverted to the United Kingdom. A certain amount of coconut cake is manufactured in England, but hitherto practically all the palmnut kernels produced in Nigeria and other British Colonies have been exported to Germany.

Further, the closing of the German market has made it necessary for such parts of the Empire as depend largely on the export of copra and palmnut kernels to find new markets, and efforts are being made to establish new coconut and palmnut kernel crushing industries in the United Kingdom. The success which might attend the establishment of such industries would partly depend (at any rate during the continuance of the war) on the extent to which the cakes should be disposed of to British farmers, who purchase very large quantities of feeding stuffs, and are always ready to utilise new oil cakes if they can be shown to be good value.

—The Journal of the Board of Agriculture, London, February, 1915.

A Note on the Recent Attack of Brassolis sophorae.

By L. D. Cleare, jnr., F.E.S., Biological Department.

THE Coconut Palms in Georgetown suffered from another attack of *Brassolis Sophorae* during the past year. In this attack a few points were noticed that seem peculiar and may be noted here. The insect has been previously investgated by Mr. Bartlett in 1905, his report being published in the "Official Gazette" of October 28, 1905, and by Mr. Stockdale in 1908 and an article entitled "A Caterpillar Pest of Coconuts" by him was published in *The Journal* of July, 1909 In this article he gave a popular account of the life-history of the pest

Brassolis was recorded from the colony as early as 1848 by Schomburgk in his *Fauna und Flora von Britisch Guiana*, but he does not give the food-plant. The present attack was not confined to the coconut palm, the common "Cabbage Palm," *Oreodoxa oleracea*, being also affected.

This pest has been previously recorded from Mahaicony district on the East Coast, from Berbice, and from Onderneeming, Essequebo. It is probable that *Brassolis* is to be found along the entire coastlands. Outside of the colony it is recorded from Dutch Guiana and the Island of Trinidad

A noticeable thing in this attack was the way in which the pest spread. While the exact place of origin is not known observations points to La Penitence or some spot in its vicinity. They then spread from south-west to north-east in direct opposition to the prevailing winds. The insects did not cross the river in spite of the wind being in their favour. This, however, was probably due to their feeble powers of flight. In the same way, Kitty Village remained untouched throughout the whole period, whilst Albert-town, separated from it by but a few empty blocks, was by far the worst affected ward in the city. Although practically the whole of Georgetown was affected, there were blocks in the midst of infected area which remained untouched. Not a single tree in the avenue along the Sea Wall was attacked though the adult insects were observed in this vicinity on more than one occasion.

THE LOSS IN MONEY.

By September the insects had practically disappeared and a census of the dead palms was taken. In the whole town there were counted about one hundred and seven dead palms. It is estimated that there were about two thousand of these palms in the city, so approximately five per cent. (5%) had succumbed to this attack. Since September several other trees have died so that five per cent. can be considered a safe estimate. Some idea of the financial loss caused by this insect can be gained by making some simple calculations. The average age at which a tree begins to bear is about five years; and taking the average return at $1 per tree per annum (this being the usual estimate) the loss of 107 dead trees is $535. To this must be added the loss caused through damage to the remaining nineteen hundred, for they will take eighteen months to recover from their defoliation At the same rate this would amount to $2,850, making a total of $3,385. This estimate is for the city of Georgetown alone If the loss in the coconut districts be taken at the same figure the amount would probably be startling.

Fortunately *Brassolis sophoræ* has many natural enemies. The common Kiskadee (*Pitangus sulphuratus*) and many other birds feed on the butterflies, while both the eggs and the pupæ are parasitized. It is only when natural conditions are adverse to these parasites that the pest gains a foothold and causes extensive damage.

The methods of control are simple, and although they have often been repeated they may be repeated once again. The habit the larvæ have of feeding almost exclusively at night and living in 'nests' during the daytime offers the easiest means of control. The 'nests' can be located from the ground and a boy sent up the tree to cut down the leaves bearing them. When the leaves fall to the ground care should be taken to destroy all the caterpillars in the 'nests.' This can be done either by immersing them in a pail containing water and kerosene oil or simply by crushing.

Meeting of the Board of Agriculture.

A MEETING of the Board of Agriculture was held on October 16th, 1914, His Excellency the Governor (Sir Walter Egerton, K.C.M.G.) presiding.

The President said that it had come to his knowledge that Mr. Quelch was leaving the Colony shortly. He thought that in recognition of his many eminent scientific services to British Guiana Mr. Quelch should be asked to become an honorary member.

Mr. Quelch thanked His Excellency and said he would be pleased to accept the honour.

REPORTS.

The following were among the reports submitted :—

Appointment of Mr. A. Seton Milne, M.R.C.V.S., as Government Veterinary Surgeon.

Abandonment by the West Bank Farmers' Association of their Agricultural Show for 1914–15 and the refunding to the Treasury of the amount given towards the expenses of the Show.

Germination of only 630 out of 30,404 seeds of *Elais guineensis*—2·07 %.

Areas under experimental cultivation by the Departmemt of Science and Agriculture :—

	Acres.		Acres.
Rubber, Para ...	99	Fruit Trees	4½
,, Sapium ...	2	Oil Palm	3
,, other sorts...	1	Castor Oil	1½
Limes ...	32	Tonka Beans... ...	1½
Coconuts	30	Bananas	1
Coffee	23	Cotton, Sisal, Ginger-lilies, *Carludovica*, &c.	1
Cacao	19	Ground Provisions ...	5 to 10
Sugar-cane	20		
Rice	7		
Balata	6		

PLANT DISEASES AND PESTS COMMITTEE.

On the motion of the Chairman, seconded by the Hon. C. Clementi, Regulation 4 of the Regulations relating to the Plant Diseases and Pests Committee was revoked and the the following enacted in its place :—

The Committee shall have the following powers :—

(1.) To carry on all correspondence relative to its duties with the Government through the Chairman or Deputy Chairman of the Board.

(2.) To carry on all other correspondence relating to its duties through the Secretary of the Board.

(3.) The functions and powers of the Board under Ordinance No 21 of 1903, the Importation of Plant Diseases Prevention Ordinance, 1903.

(4.) (a) To act under the provisions of the following Sections of the Plant Diseases and Pests (Preventive) Ordinance No 12 of 1914 :—Nos. 3, 4, 5, 6 and 8.

(b) To assess for the purposes of Section 9 the value of any crops, trees or bushes removed or destroyed under any order issued under Section 6.

(5.) Any other duties that may be required in connection with the control of Plant Diseases and Pests.

SPECIFIC PESTS.

It was decided to add to the list of plant pests proscribed the following :—

"Love Vine" (*Cuscuta* spp.)

"Bird Vine" or "Miseltoe (*Loranthus* spp.) on Para Rubber, Cacao, Coffee, Citrus and other fruit trees.

Orders were adopted for the suppression of Witch-broom of Cacao, Bud-rot of Coconut, *Brassolis sophorae*, and for the disposal of all dying and dead palms.

INSPECTORS.

The following were appointed Inspectors under Section 4 of the Plant Diseases and Pests (Prevention) Ordinance :—

Officers of the Local Government Board :—

The Inspector of Districts.

The Assistant Inspector of Districts.

The Government Medical Officer of Health.

The Government Sanitary Inspectors.

Officers of the Board of Agriculture :—

The Agricultural Superintendent.

The Horticultural Superintendent.

The Government Veterinary Surgeon.

The Agricultural Instructors.

The Agricultural Assistants.

The District Commissaries in charge of the various Fiscal Districts.

The Commissioner, North West District.

The Stipendiary Magistrate, Pomeroon District.

H. W B. Moore, Esq.

NO ANNUAL LIVE STOCK SALE.

The Chairman reported that owing to the small amount of stock available for sale, the Live Stock Committee did not recommend the holding of the usual annual auction sale.

COLONY FREE FROM MAL DE CADERAS.

The Chairman reported that the Colony was free from the equine disease, Mal de Caderas, the animals affected having died or been slaughtered : and that the Veterinary Committee were unable to recommend that compensation be awarded to Plantations for animals destroyed through Mal de Caderas. He moved the adoption of the findings of the Committee : and this was carried.

A licence to kill wild birds was issued to Mr. M. A. de Freitas and permission to export bird skins was granted to Professor Dr. A. G. Ruthven of the University of Michigan, U. S. A.

Meteorological Returns for the Year 1914.

Taken at the Botanic Gardens, Georgetown.

	Temperature.						Humidity.		Sunshine	Rain-fall.	Wind.	
	Solar Maximum.	Minimum on Grass.	Shade Maximum.	Shade Minimum.	Range	Corrected Mean.	Midday.	Night.	No. of hours daily.	Amount in Inches.	General Direction.	Average Force.
January ..	148·9	71·5	83·5	74.7	8·8	78·5	69·5	80·1	7·9	1·79	N.E	1·0
February ..	148·6	72·6	83·6	75·4	8·2	78·9	71·6	81·3	6·3	2·46	,,	1·1
March ...	149·4	72·0	84·5	74·9	9.6	79·1	64·8	79·0	8·1	2·34	,,	1·0
April	148·5	72·9	84·6	75·6	9·0	79·5	70·3	81·1	6·6	4.22	,,	1·1
May ..	139·6	73·2	83·1	75·2	7·9	78·6	80·0	87·5	4·9	18·37	,,	1·0
June .	143·7	73·5	84·3	75·2	9·1	79·2	74·5	90·3	6·8	9·25	,,	2·0
July .	143·7	72·4	85·5	74·8	10·7	79·6	71·1	84·4	8·2	5·37	,,	1 1
August	149·0	73·0	86·5	75·3	11·2	80·3	67·8	84·8	7 9	4·40	,,	1·1
September	150·0	72·8	86·9	75·6	11·3	80·7	67·4	83·3	8·7	5·18	,,	2·0
October ...	151·4	73·1	87·0	76·3	10·7	80·1	63·9	83·1	8·4	4·80	,,	1·0
November	149·0	72·8	86·4	72·8	13·6	79·0	67·5	87·0	7·2	4·81	,,	1·0
December	146·9	73·1	84·5	76·1	8·4	79·7	72·0	85·7	5·9	6·50	,,	1·0
Mean ...	147·4	72·3	85.0	75.1	9·8	79·4	70·0	83·9	7·2	.		1·2
Total...	...	. .	...	..	..		..		.	69·49		. .

Hints, Scientific and Practical.

The Importance of Lime in the Soil.

Mr. HALL, in his presidential address of the British Association in Australia, in referring to the subject of soil exhaustion, indicated the chief factors which influence fertility as rainfall, the physical condition of the soil. and the presence of lime.

He attaches so much importance to the last as to place it first among these factors, inasmuch upon the presence of carbonate of lime in the soils depends the production of available plant food as well as the natural regeneration of the soil.

This important agent being entirely under the control of the agricultnrist, there should be no excuse for its absence from our cultivated areas. Our (Ceylon) soils are generally deficient in lime, which however is easily obtainable

—Tropical Agriculturist, March, 1915.

Preserving Cut Flowers.

COMPREHENSIVE experiments carried out by Professors B. M. Gugger and Lewis Knudson at Cornell show, that little, if any, effect is produced on cut flowers by additions of salts. The trials were made with Cosmos, Petunia, Aster, Verbena, Violet, Coreopsis, Dahlia, *Tegetes erecta* and *T. patula*, Geranium, Zinnia, Sweet Peas and Pansies. Many different solutions were tried, including those of calcium nitrate, zinc sulphate, copper sulphate and common salt. Mixtures of salts were also employed. In no case was any striking result obtained, though not infrequently the treated flowers kept a day or so longer than those put into plain water. The fouling of water due to bacterial action, which takes place when certain cut flowers are kept in water, may be prevented by the addition of a trace of zinc sulphate or of copper sulphate. Boiling, burning or mashing the cut ends of the stems—processes which are often recommended—proved useless, but the daily removal of the cut end—as is so commonly practised—was found to prolong the life of the flower.

—Gardeners' Chronicle.

Clean Packing of Rubber.

THE desirability of packing plantation rubber in such a manner as to exclude contamination with wood splinters, dust, etc., has been so frequently discussed, that it is not a little remarkable that so far very little, in a practical way, has been attempted in this direction. Tea, an article which sells down to about 4d. per lb., is carefully packed in lead foil; plantation rubber worth, were in these times, 2s. per lb. is stowed, unprotected, in wooden cases.

Planters should bear in mind the fact that one of the greatest advantages of the plantation over the wild article is that it can—or should—for most purposes be used without washing in the factory. The expense involved in washing and drying rubber at the works is considerable, but quite apart from this, the washing operations undoubtedly affect quality. Experience has shown that a comparison between wild and plantation rubbers, when both varieties have been factory washed, does not necessarily give an accurate idea of the relative value of the two articles. Wild rubber must be washed; plantation, if clean and dry, can, for the manufacture of most goods, be taken straight to the mixing rolls.

There is no reason why *all grades, including earth and tree scrap, of plantation rubber* should not be sent home absolutely clean and ready for use. As a very simple and inexpensive solution of the packing problem I suggest that the cases should contain a loose liner of cloth, simply folded over the top. These cloths could be readily washed and returned with the empty cases or separately. The cloth should be of the type so widely used in rubber works for calendering and wrapping, etc. Well boiled, this type of cloth sheds no "fluff," and the mere fact that it is used all through the factory is sufficient evidence of its practicability in this connection. The cost of these cloth liners would be infinitesimal. I suggest to dealers that they approach manufacturers and offer them (naturally after coming to some suitable arrangement with producers) plantation rubber packed in the manner suggested at, say, 1/16th of a penny per lb. over goods packed in cases in the ordinary way, or alternatively that planters should take the bull by the horns, and send home small consignments put up as indicated. I feel sure they would find it well worth their while.

—India Rubber Journal.

Fungicidal Action of Bordeaux Mixtures.

In order to throw more light upon the general action of copper fungicides, and, if possible, to obtain further evidence in support of conclusions previously reached, experiments have been made to determine the action of copper compounds on plant cells other than those of fungi. The tests were made with broad bean, pea, and mustard seedlings, the root hairs of which provide types of cells comparable with the germ-tubes of fungus spores and the cells of actively growing hyphæ, and with apple leaves.

It was found that in some cases the root hairs were killed, deformed or discoloured as the results of the treatment, while in other instances they appeared to be uninjured. If the injurious action was due to the production of soluble copper by agencies other than the cell itself, the whole root-hair system should have been fairly equally affected instead of showing the extreme variations noted. It appeared, therefore, that living cells with readily permeable walls of the unchanged cellulose type or its equivalent are able to produce and absorb soluble copper from insoluble compounds.

The fate of the organism depends upon the relation between the amount of soluble copper produced and absorbed, and the rate of growth of the organism. This is a significant point in connection with practical spraying, since it explains why there may be at times little check to the growth of a parasite fungus after spraying, especially when the parasite has once gained a footing on the host plant.

Cells with walls of an impermeable character, such as those of apple leaves, possess no such power of solvent action upon insoluble copper compounds. In the case of apple leaves, only when there is injury to the cuticle sufficiently recent for no occlusion to have taken place, or when there is some radical alteration in its nature, is soluble copper produced.

Under changed conditions, cells with normally impermeable walls may become permeable and capable of action upon insoluble copper compounds. The difference in behaviour of apple foliage in summer and autumn would seem to be best explained in this way; and the change in the nature of the cell wall may be attributed to incipient death of the cells preparatory to leaf fall. This explanation accords with the fact that the hairs on the under surface of apple trees (which

are decadent cells) are affected by contact with the copper compounds even in early summer when the epidermal cells (being full of life and vigour) remain unattacked.

It is evident, therefore, that the nature of the cell wall is the determinative factor in the direct action of the cell upon the Bordeaux compounds. It is stated that a comparison of the conclusions now reached with those derived from the previous experiments with cells of fungi shows that two distinct lines of work have led to indentical results.

—The Journal of the Board of Agriculture, London, April, 1915.

Acclimatisation of Live Stock in Brazil.

SINCE it is probably in the State of Sao Paulo that the greatest efforts in the direction of stock raising and the testing of the suitability of various foreign breeds have been carried out, some detailed particulars as to the conditions prevailing in this State may be given.

Themean annual temperature of the State is 64° F., with a maximum in summer of 100° F. and a minimum in winter of about 30° F.; the minimum is rarely found, and cold is not often general but is limited to a few places. Imported animals seem to bear the summer very well, especially when the precaution (which in general) is taken of housing them during the hottest part of the day. Animals are, however, generally imported in winter and are already more or less acclimatised by the hot season. It seems that cold is more to be feared than heat.

As regards rainfall, the danger of the rainy season (in summer) lies rather in the prevalence of insects than in any harm caused directly by rain. In the dry season (winter) there is a lack of good pasturage. The natural pastures of the country are composed of poor gramineous herbage, but these are furthest from civilisation, the pastures of districts nearer the capital being practically all artificial and apparently well suited to fattening live stock. Feeding of newly-imported animals presents no difficulties.

From the point of view of acclimatisation of cattle the most important disease is certainly red-water; an account of the progress in regard to this disease in Sao Paulo may be given

About ten years ago, of an importation of 315 breeding animals from Europe and Argentina only 7 were found to survive, the rest dying from red-water. It has since been found that the losses among imported animals are much reduced (1) if only young animals (12 to 14 months) are imported, as these have proved to be much more resistant than mature animals; (2) if no pregnant animals are imported, as these abort when attacked and generally succumb; (3) if importation is only undertaken during the Brazilian winter (May to September), so that animals suffer less from changes climate; and (4) if immunisation is carried out as soon as possible, either naturally or artificially by the application of a limited number of ticks, or by subcutaneous injection of virulent blood from an animal recently recovered from an attack of the disease.

The mortality among imported animals was reduced to 33 per cent. in 1908, 13 per cent. in 1909 and to 7 per cent. in 1910. The certainty of acclimatisation of imported animals cannot yet, however, be guaranteed.

It has been established that red-water is present on all the stock-breeding farms on the State of Sao Paulo, so that immediate immunisation of young breeding stock imported against the disease is imperative if the animals are not to succumb when they reach maturity. In addition to red-water (*Piroplasma bigeminum*). recent research has shown Anaplasmosis (*Anaplasma marginale*) to be prevalent and to be, if anything, more grave than the former.

The work of Sir Stewart Stockman, Professor Nuttall, and Dr. Arnold Theiler having shown excellent results to be obtained from trypan blue, experiments have been carried out in Sao Paulo, and the results fully confirm the finding of these investigators. As trypan blue does not destroy all parasites the immunity conferred is of a permanent nature. In the injection of virulent blood previous to the use of trypan blue it is necessary, however, to eliminate all *Anaplasma marginale* parasites.

Sir Stewart Stockman states that animals immunised against red-water have an increased resistibility against anaplasmosis. Dr. Arnold Theiler is of opinion that immunisation with *Anaplasma marginale* var. *centrale* is the best method of conferring resistibility against anaplasmosis.

M. L. Misson, the Director of Animal Industry in Sao Paulo, comes to the conclusion that it would be much preferable to carry out immunisation of animals against red-water in Europe some time before embarkation.

The immunisation of animals against red-water is undertaken at the cattle-testing station of the board at Pirbright, Surrey. Through the instrumentality of the Chief Veterinary Officer of the Board more than 300 animals have been immunised in the last few years and shipped to various countries, including Brazil, and reports on the animals after landing in infected countries have been highly satisfactory.

Other than red-water the most frequent enzootic diseases in the country are symptomatic anthrax and antinomycosis in cattle, glanders and a trypanosomiasis peculiar to South America in horses; rabies, and vermicular pneumonia in goats. Cattle plague does not exist, and up to the present, there has been no case of bacteriological anthrax.

To secure the grants given in respect of imported animals such animals, must *inter alia*, be submitted to the tuberculin or mallein tests before shipment. The tuberculin test is also undertaken at the Board's Cattle Testing Station.

—The Journal of the Board of Agriculture, London, March 1915

Co-operation and Small Holdings in England.

As regards the local Credit Societies formed for the purpose of making short term loans to their members, the report states that at the end of 1913 these Societies numbered 4,533 with 236,860 members, an average of fifty-two members per society. They had a paid-up capital of £597,390 and during the year they made new loans to members amounting to £3,861,000 and recovered loans previously made to the amount of £3,509,000, the amount out on loan at the end of the year being £2,982,600. Their reserve funds at the end of the year amounted to £115,000.

—The Journal of the Board of Agriculture, London, April, 1915.

Answers to Correspondents.

G. S. H.—The specimens submitted for examination are infected with a leaf disease caused by a minute fungus organism known as *Passalora heveæ*, Massee. It attacks both the leaves and young green shoots of the rubber tree, causing in cases complete defoliation of the tree. A description of the disease is given in the Journal of the Board of Agriculture, Vol. VII., No. 1., p. 37.

E. M.—The cacao pods collected from the East Coast, Demerara, are what are known as indurated pods affected with the "witch-broom" disease of cacao.

R. W.—The diseased peppers are attacked by *Colletotrichum nigrum*, Halstead. Spraying with bordeaux mixture is very effective in checking this disease.

E. S.—The cacao pods are attacked by the "brown rot," *Diplodia*. Spraying has proved efficacious in the control both of "black rot" and "brown rot" of cacao pods. As predicted by the Department in 1896.

N. Y. D.—Your rose trees are affected by "crown gall" causing numerous swellings on the roots. You should destroy such plants, avoid the use of large quantities of pen manure, and drain the beds as thoroughly as possible.

E. M. P.—The rice is affected by "blast" caused by a fungus *Piricularia oryzae*. Nitrogenous fertilising is one of the principal conditions favouring the disease. A seed selection by specific gravity, using 1 per cent. copper sulphate solution is recommended.

—C. K. B.

The Value of Manure for Sugar-Cane.

Recent experiments conducted in various parts of Hawaii have shown that plant cane from an unmanured field will yield from 25 to 30 tons of cane per acre whilst by judicious manuring these figures reach as high as 40 to 42 tons per acre, and 4 to 6½ tons of sugar per acre were obtained from the completely manured plots against 3 to 4¼ tons where Unferrilred.

The Model Gardens.

Record of Attendances.

Below is given a table, arranged in quarterly periods setting out the number of pupils who attended the Model Gardens of the colony from Jan. 1, 1908. These quarters (recorded below as 1st, 2nd, 3rd and 4th) run from January 1 to December 31. The totals only during 1908, 1909, 1910, 1911 and 1912 are given; the records since then are in detail

Quarters.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank. Dem.	Suddie, Essequibo.	Den Amstel.	Houston, E. B.	Wakenaam.	Total Attendances.
1908.										
1st–4th	5,447	3,386	1,477	887	1,053	160	...	...	...	12,410
1909.										
1st–4th	6,473	2,665	1,738	1,277	1,192	1,897	662	...	...	16,904
1910.										
1st-4th	5,026	2,297	3,269	2,348	1,151	1,947	1,984		1,532	19,554
1911.										
1st-4th	5,129	1,519	3,600	2,869	1,406	1,509	2,230	2,561	2,444	23,267
1912.										
1st-4th	5,514	1,392	4,395	3,302	1,780	2,100	2,544	2,156	1,708	24,891
1913.										
First	1,613	464	1,060	637	529	764	661	464	342	6,534
Second	1,273	498	1,368	863	517	766	653	508	401	6,847
Third	1,176	495	904	670	498	945	736	475	333	6,232
Fourth	1,094	505	1,203	349	451	924	518	389	243	5,576
1914.										
First	1,134	481	1,245	624	564	1,014	475	498	370	6,405
Second	1,047	489	1,008	699	322	726	428	425	263	5,407
Third	1,087	481	844	667	451	728	368	369	511	5,506
Fourth	975	535	772	453	536	557	520	351	389	5,098
1915.										
First	1,123	641	1,006	769	4,906	59	503	339	401	5,931

By a resolution at the Annual Session in March, 1915, the Combined Court declined to vote the money for the upkeep of the Model Gardens; which were in consequence cropped and abandoned.

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during instruction given by the Superintendent Teacher. It has not yet been found feasible to keep reliable, full records of the very numerous attendances during his absence.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the year 1914. The corresponding figures for the three previous years are added for convenience of comparison.

Product.	1911.	1912.	1913.	1914.
Sugar, tons ...	98,459	77,788	87,414	107,137
Rum, gallons ...	2,595,293	2,382.937	3,260,986	3,489,729
Molasses, casks ...	1,106	1,760	1,187	832
Cattle-food, tons ...	5,556	5,116	6,859	2,426
Cacao, cwts. ..	798	102	505	577
Citrate of Lime, cwts.	56	½	36	99
Coconuts, thousands	1,038	1,042	872	1,890
Copra, cwts. ...	1,415	1,149	1,127	1,690
Coffee, cwts. ...	927	1,293	797	2,105
Kola Nuts, cwts. ...	4	...	1	4
Rice, tons ..	2,538	2,721	7,709	7,090
Ricemeal, tons ...	1,364	2,005	1,802	241
Cattle, head ...	953	497	965	1,172
Hides, No. ..	4,617	4,230	5,106	4,646
Pigs, No. ...	1,148	1,159	1,604	1,303
Sheep, head ..	40	71	40	141
Balata, cwts. ...	10,289	6,296	11,817	9,131
Charcoal, bags ...	72,937	67,573	62,321	67,450
Firewood, Wallaba, etc., tons	9,866	8,759	8,670	10,204
Gums, lbs. ...	4,652	4,958	2,237	886
Lumber, feet ...	327,328	223,751	517,819	254,772
Railway Sleepers, No.	5,432	5,280	11,020	10,627
Rubber, cwts. ...	32	2	11	9
Shingles, thousands	2,500	2,562	2,645	1,806
Timber, cubic feet...	234,003	284,530	437,111	212,418

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported from Jan. 1 to March 31, 1915. The corresponding figures for the previous years are added for convenience of comparison.

Product.	1912.	1913.	1914.	1915.
Sugar, tons ..	15,252	13,855	17,470	21,259
Rum, gallons ..	902,210	942,333	993,903	1,216,036
Molasses, casks ..	650	505	628	...
Cattle-food, tons ..	1,566	2,830	765	374
Cacao, cwts. ...	5	...	209	187
Citrate of Lime, cwts.	...	...	..	17
Coconuts, thousands	716	263	579	486
Copra, cwts. ...	710	329	490	589
Coffee, cwts ...	469	509	927	334
Kola Nuts ...	...	...	...	2
Rice, tons ...	1,136	1,181	2,921	3,071
Rice-meal, tons ...	531	705	98	170
Cattle, head ...	141	177	370	196
Hides, No. ...	722	1,549	1,738	753
Pigs, No. ...	242	544	360	267
Sheep, head ...	6	4	6	2
Balata, cwts. ...	212	1,928	2,078	3,289
Charcoal, bags ..	18,544	14,809	22,076	12,939
Firewood, Wallaba, etc., tons ...	2,817	2,191	3,215	1,914
Gums, lbs. ...	446	1,332	...	...
Lumber, feet ...	46,073	66,611	120,190	8,877
Railway Sleepers, No.	1,556	1,503	502	53
Rubber, cwts. ...	1	4	...	7
Shingles, thousands	207	703	254	441
Timber, cubic feet	63,286	124,038	73,184	37,434

Selected Contents of Periodicals.

Capillary Constants and their Measurement.

Militarism and Party Politics

—Science Progress, January, 1915.

Some Aspects of the Atomic Theory.

The Authocyan Pigments

The Prevision of Earthquakes

The Electrical Properties of Conductors at very low Temoeratures

—Ibid : April, 1915.

Agricultural Experiment Gardens in connection with Public Schools.

Rejuvenation of Banana Plantations.

—Queensland Agricultural Journal, March, 1915.

Aberdeen Angus Cattle.

Sunflower growing for Seed.

—Ibid . April, 1915.

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A Special Number.

By order of His Excellency, the Governor, we publish in this issue an article on "The Field and Forest Resources of British Guiana"—written originally for, and published by, *The Bulletin of the Imperial Institute* by the Director and Assistant Director of the Department of Science and Agriculture. The article gives so concise a summary of the present condition and future prospects of the colony, and comes from so authoritative a source, that we are sure our many readers, in and out of British Guiana, will welcome the opportunity to study it in the convenient form afforded by *The Journal.* We would direct special attention to the authors' remarks on the possibilities of the sugar industry. It will come as a surprise to many that the readily available land well-suited to the cultivation of sugar-cane in the eastern part of the colony could produce *one million tons of sugar*, whilst there is available land suitable for sugar cultivation in the North West to increase this quantity of 2,500,000 tons a year! It is such facts as these which justify optimism in the future—an optimism modified by the uncertainty of the political outlook. It has been well said that 'all the troubles of the sugar planter have been political.'

In addition to the article on the resources of the colony, we are able to offer our readers the first of a new series on the "Cultivation of Limes in British Guiana." The importance of

this crop is becoming more and more evident, and the suitability of this colony for the growth of the fruit has already been abundantly proved. Since the previous series of articles appeared in The Journal much local experience has been gained, and the results of this, with many useful hints, are embodied in the contributions by Professor Harrison and Mr. Bancroft.

Lastly, the interesting experiments on the hybridisation of Cotton, commenced in 1902, have been successful in producing a Buck x Sea Island cross yielding a cotton of long staple which is of great promise. It is noteworthy that this important result has been brought about by careful *field selection* and was obtained in the F_4 generation. Details are to hand in yet another communication from the Department of Science and Agriculture.

These valuable papers are fittingly presented to our readers in this Special Number.

Science and "Refinement."

Another reason for the lack of recognition (of science) is the attitude of the older Universities and the English Public Schools. By them science as a profession is looked upon as one lacking in the essentials of refinement, and there can be no doubt this social stigma has had much to do with keeping able men of good position from entering it. Law and the Church, on the other hand, have always enjoyed high approval, one reason being no doubt that in these professions the ultimate prizes to be gained in after life are vastly superior. They are, however, limited in number, and as Sir William Tilden remarked at the deputation to the Government already referred to, 'a large proportion of able young men who might otherwise take up chemistry as a pursuit are led into the ranks of other professions, especially the Law, in which there are prizes for the few but disappointment for the vast majority.'

Agricultural News," Barbados, September 11, 1915.

Science and Education.

By Sir Ronald Ross, K.C.B., M.D., etc.

Two of the best papers read during the Australian Meeting of the British Association were by Prof. John Perry and Prof. H. E. Armstrong, upon the subject of science and education. Both speakers deplored the low place now taken by science in education, and indeed in the State generally. Prof. John Perry says that "the classics ride us like Sinbad's old man of the sea. All over the British Empire a well-educated man cannot become a professional man of almost any kind unless he pretends to know something of one or more dead languages, such knowledge being of no essential value to him. It is something like what the old Test Act imposed upon us; for a hundred and thirty years a British citizen perfectly competent to fill the highest posts could not take upon himself the smallest kind of public work unless he could swear to a certain formula." "The worst of it is that the average boy who has done almost nothing else than Latin and Greek at school gets absolutely no love for the classics: he never reads Greek or Latin after he leaves school." "One of the curses of intellectual England is due to schoolmasters keeping men at school and treating them as boys until the age of twenty-one. They take scholarships as stall-fed cattle take prizes at agricultural shows." "Genius is very common in both countries, but 99 per cent. of it is destroyed by the schools." "Any ordinary citizen thinks himself fit to be a member of the governing body of a school or college, and the disasters due to this belief are worse than what would occur if we gave to such men the command of ships. The ordinary man, especially the parliamentary man, who thinks that the members of a committee on such scientific business ought all to be non-scientific men will jeer at this statement, but it is, nevertheless, fatally true."

THE LITERARY TYPE.

Prof. Armstrong is equally vigorous. "Our schools," he says, "are for the most part in literary hands; and it would almost appear that literary and scientific interests are antagonistic, so unsympathetic has been the reception accorded to science by the schools." "By placing classical scholars in charge (of schools), we seem unconsciously to have selected men of one particular type for school service—men of the literary type; and this type has been preferred for nearly all school posts, mainly

because no other type has been available, this being the chief product of our universities. Such men, for the most part, have been indifferent to subjects and methods other than literary—I verily believe not because they have been positively antagonistic or lacking in sympathy, but rather because of their negative antagonism." "The literary type of man apparently does not and cannot sympathise with the practical side of modern scientific inquiry, because he has neither knowledge of the methods of experimental science nor the faintest desire for such knowledge."......"To improve our system we need to get rid of our blind British belief in 'men of affairs,' especially in the 'man of business' so-called—really the man of commerce—as persons capable of ordering everybody's affairs and everybody's business." "Science must be organised, in fact, as other professions are organised if it is to be an effective agent in our civilisation."

TWO POINTS AT ISSUE.

There are really two points at issue in these papers, first the general British disinclination for scientific work and thought, and secondly, the rejection of science in education. Every one deplores the former defect, but we do not see clearly how it really depends upon the latter. There has grown up an entirely unreal system of education—as unreal as 'the square root of minus one,' but as much loved by some people as is that mysterious entity or non-entity by others. Just as mathematicians make books out of their imaginary quantities, so do schoolmasters try to make men out of theirs—and in both cases the results are apt to be more curious than useful. We would be the last to object to a true classical education; but then that education must always be combined with a scientific one. Unfortunately what the boy really receives is not a classical education at all, but a grammatical one—quite another thing. Nothing is more educative than a knowledge of the masterpieces of literature in all languages; but our youths do not receive any such instruction. It is doubtful whether many of them have ever even read through the Iliad so as to understand the wonderful construction and the wisdom of the great fable which it develops for the purpose of adding wisdom to mankind. This is not taught, but the boy is kept writhing on the gridiron of grammatical difficulties. Even with regard to English literature the masterpieces are not read by the boys in an intelligent manner, but are merely used for philological texts. The result is that few of our young people are even acquainted with the masterpieces of literature, and are certainly ignorant of their beauty and incapable of appreciating it. Thus when they grow up their minds are content with the most trifling fiction

and the most puerile drama. Similarly, even in the teaching of mathematics, our boys are kept trifling in the porch—worrying over permutations and combinations or burrowing into the depths of conic sections, when they should be taken to the top of a mountain and be given a wide survey of the whole field. Thus they too are instructed only in the ground work, and remain for all their lives ignorant of the main meaning and scope of what was intended to have been taught to them. When we add to such negative teaching all the facts of nature discovered laboriously by many great workers, the square root of the sum results in the modern Briton—at least so far as his knowledge goes.

We do not wish to see any branch of knowledge removed from the curriculum. All knowledge is valuable; but we do not wish to see the receptive years of youth wasted upon unimportant knowledge when they might be used for the acquisition of important facts. The real fallacy of the schoolmaster is his supposition that education is valuable chiefly as an exercise and not as an opportunity for laying in stores of information. If this were the case. nothing should be more carefully taught in schools than the game of chess, which is perhaps just as good an exercise in many respects as are mathematics or classics. But the time of youth is short, and the opportunities soon vanish; and the boy kept trifling in the porch is apt, when he becomes a man, to leave it abruptly with some anger in his heart and without ever having entered the beautiful temple within.

SCIENCE PROGRESS.

Germany's Control of its Industry.

The vagaries of the German government under the varying conditions brought about by the great war now in progress are singularly displayed in the permissions and prohibitions incident to the sugar industry since they were first uttered. On July 31, 1914, the export of sugar was prohibited. On September 17 the export was permitted under licence. On October 5 the export was permitted up to 1,200,000 tons; twenty-two days later, on October 27, permission to export up to 1,200,000 tons was cancelled. On February 6. 1915, export under licence was terminated and prohibition was absolute.

Louisiana Planter," June, 1915.

The Field and Forest Resources of British Guiana.

By Professor J. B. Harrison, C.M.G., M.A., F.I.C., etc., Director, Department of Science and Agriculture, and C. K. Bancroft, M.A., F.L.S., Assistant Director and Government Botanist.

SITUATION AND EXTENT.

British Guiana lies between latitudes 0° 41′N (source of the Essequebo River) and 8° 33′ 22″N. (Punta Playa), has a depth from North to South of about 500 miles, a seaboard of about 270 miles trending in a south-easterly direction, and occupies in the north-east of South America an area approximately equal in extent to Great Britain. It is bounded on the north by the Atlantic Ocean, on the east by Surinam or Dutch Guiana, on the south and south-west by Brazil and on the west by Venezuela.

The colony may be divided broadly into three belts. The northern one consists of a low-lying flat and swampy belt of marine alluvium—the coastal region. This rises gradually from the seaboard and extends inland for a distance varying from 5 to 40 miles. It is succeeded by a broader and slightly elevated tract of country of sandy and clayey soils. This belt is generally undulating and is traversed in places by sand-dunes rising from 50 to 180 feet above sea-level. The more elevated portion of the colony lies to the southward of the abovementioned regions. It rises gradually to the south-west, between the river valleys which are in many parts swampy, and contains three principal mountain ranges, several irregularly distributed smaller ranges and in the southern and eastern parts numerous isolated hills and mountains. The eastern portion is almost entirely forest-clad, but on the south-western side there is an extensive area of flat grass-clad savannah land elevated about 300 feet above sea-level.

AREA AND POPULATION.

There are estimated to be 57,770,000 acres of land in British Guiana of which only about 2,000,000 acres are alienated from the Crown. The remainder is open for beneficial occupation and it is estimated that of this vast area over 9,000,000 acres are easily accessible. The major portion of the easily accessible area is suitable for the cultivation of many tropical products.

The population is at present estimated to be 304,149 and consists of British, Portuguese, Blacks, and their descendants, East Indians, Chinese, and Aboriginal Indians. The population is distributed among the various races in the following proportions:—

Europeans	14,000
Including 10,000 Portuguese	
East Indians	130,000
Chinese	2,600
Aboriginals	7,000
Blacks	115,400
Mixed and others	35,000
	304,000

The greater proportion of the East Indians are associated with the sugar estates and with cultivations such as rice on the coastal lands, while the forest industries and gold and diamond mining are to a large extent carried on by persons of the African race.

CLIMATE.

British Guiana has been at times described as an unhealthy colony. This is an undeserved calumny, as clearly shown by the statistics of mortality of European races other than Portuguese. For those who lead regular lives and do not expose themselves to unnecessary risks the climate is decidedly a healthy one. The coastlands are swept throughout the year with the north-eastern trade winds which add greatly to the comfort vigour and health of those resident thereon.

RAINFALL.

The mean annual rainfall near the coast is about 94 inches and further inland about 105 inches.

The distribution of the rainfall is fairly even: on the coastlands from the month of August to the month of November it is usually drier than at other periods of the year, the precipitation amounting during these months to an average per month of about 2.5 ins. Away from the coast the distribution is more even, and in the forest regions there is no marked dry spell. In the Savannah country of the hinterland, the far interior of the colony, the rainfall is less regular; there the average an-

nual precipitation amounts to 55 inches, the period from November of one year to March the following year being usually very dry.

TEMPERATURE.

The average mean shade temperature at or near the coastlands for the past twenty-two years is 80.0° F. The average mean maximum is 85.1° F. and the average mean minimum 74.9° F. The greatest annual range is about 19° F.

Recent comparative records of air temperature at three representative recording stations,—Georgetown (coastland), H.M. Penal Settlement (Mazaruni River, 42 miles direct from the coastland) and Dada-nawa in the Rupununi district. 280 miles from Georgetown in the far interior of the colony—are shown in the following table:—

Station.	*Average Annual shade temperature*	*Mean Maximum*	*Mean Minimum*
Georgetown	80.4°F	85.7°F.	74.7°F.
H.M. Penal Settlement..	79 7° „	88.2° „	76.4° „
Dada-nawa	82.6° „	92.2° „	72.3° „

SOIL.

The results of the examinations of the various parts of the colony and of the soils characterising them have shown that it must be divided into three great belts, each of which has its own special economic resources.

The belts are as follows:—

(1.) The alluvial coast belt is an agricultural one of very exceptional fertility, and its soils are probably among the richest and most fertile in the tropical parts of the world. It is well suited for many forms of tropical agriculture.

(2) The widespread belt of the lower hills and plains is covered with a seemingly inexhaustible forest containing many kinds of trees which yield timbers and other products of commercial value. As far as has been ascertained, its soils are mainly sedentary ones the decomposition-products in situ of its country rocks, and are of lower agricultural value than those of the agricultural coast belt. It has, however, been shown that on the more promising soils on the lower parts of the belt arboricultural crops such as limes and Para rubber can be successfully grown. The regularity of the rainfall, in these situations, forms an important factor in the cultivation of certain tropical products.

(3.) The savannah belt at present is practically undeveloped, but may in time become a great district for cattle ranching, whilst there are in it belts of alluvial and fluviatile soils of from fair to high fertility upon which many tropical products could be successfully raised.

LAND TENURE AND VALUE.

The principal terms and conditions on which land may be leased from the Crown for the cultivation of permanent crops such as rubber, citrus fruits, coconuts, etc., are:—

No rent is payable during the first five years of the lease, but the lessee pays an annual rent of twenty-five cents an acre from the sixth to the tenth year inclusive, and an annual rent of eighty cents an acre during the remainder of the lease, and in default of payment of such rent on the day on which the same is due, the lessee in addition, pays interest thereon at the rate of six per centum per annum for each day of such default.

The lessee shall each year plant not less than one twenty-fifth part of the land leased until he has so planted not less than seven twenty-fifth parts of the said land and shall maintain such cultivation in good order to the satisfaction of the Governor-in-Council or of such Officer as may be from time to time deputed by the Governor-in-Council to inspect the cultivation.

During the continuance of the lease the lessee shall pay the sum of two cents (1 penny) a pound for all rubber, balata, or other substances of a like nature, obtained by him from the land, *from indigenous* trees. There is no royalty on produce of planted trees.

The fees payable for obtaining a lease, which must be deposited with the application, as follows:—

Application	$5·00
Survey:—	
Areas up to 500 acres, per acre	30c.
Each acre above 500 and up to 1,000 ..	20 „
Each acre above 1,000	10 „

These charges include labour, cutting lines, etc.

The lessee is also required to pay the cost of drawing up, executing and stamping the lease in Registrar's Office, say $16.20.

For the cultivation of other products no Crown land, unless under special circumstances, is sold or granted but is rented under leases for terms of ninety-nine (99) years or under with a right of renewal, if the condtions attached to such titles have been strictly complied with, for one similar period, subject to a re-assessed rental.

The rents to be charged for such land, will ordinarily be as follows:—

For any area up to 5 acres, $1 per annum.

For areas over 5 and up to 100 acres, at 20 cents per acre per annum.

For areas over 100 and up to 500 acres, at 15 cents per acre per annum.

For areas above 500 acres at 10 cents per acre per annum.

These conditions compare very favourably with those of other tropical countries

LABOUR.

In 1911 when the last census was taken, 70,922 or 24% of the total population was engaged on sugar estates; the demand for a large supply of labour for the sugar industry has made immigration from India a necessity for its successful operation.

Immigration from India commenced in 1838, but it was not until 1845 that regular immigration recognised by the Government began. From 1901 to 1911 the average annual immigration of East Indians was 2,435. The colony is now divided into Immigration Districts, each in charge of a resident Agent, while the medical care of the immigrants is under the charge of the Medical Department. In addition to Indentured East Indians, the sugar estates employ both East Indians who have served their period of indenture and Blacks. The wages on sugar estates for field operations vary from 1s. to 2s. a day, cane-cutters earning higher wages, 1s. 6d. to 3s. 6d. A day's work for the indentured East Indian is defined by law as one of 7 hours. Those engaged in the manufacture of sugar earn higher wages, generally speaking from 1s. 6d. to 2s. 6d. per day.

The labour employed in other cultivations consists of East Indians and Blacks with some Aborigines. Wages for men

vary from 1s. 4d. to 2s. per day; women earn 10d. to 1s. ½d. and children 6d. to 8d.

AGRICULTURAL INDUSTRIES.

The chief agricultural industries are sugar, rice, coffee, cacao, coconuts, rubber, limes, and growing "provisions," such as plantains, cassava, tannias, yams, sweet potatoes, etc. Of these the principal exports are sugar and its by-products, rum, molasses and molascuit, rice, coffee and coconuts. Large increases have recently taken place in the exports of coffee and rice.

The front portion of the coastal region is in part occupied by sugar estates, whilst the bulk of the rice is grown upon this section of the colony. Provision grounds are situated at the back of the sugar estates, at the back of the coastal village lands, and on the lower reaches of rivers. Coconuts are grown on the coastal region, whilst cacao and coffee are chiefly cultivated on the river lands in their lower reaches. Rubber is being successfully cultivated on the river lands and also on the slightly elevated tract of country immediately behind the coastal region.

Cattle raising is carried on to a large extent on the very extensive flat pasture-land of the coastal region, and on a smaller scale on the savannahs of the hinterland.

SUGAR.

The sugar cane with its products is the most important of the agricultural resources of the colony. The sugar industry of British Guiana, in common with that of the West Indian Islands and of some other countries, has passed through many vicissitudes during the last quarter of a century. But the industry has fairly well held its own in the face of prices which at times have been so low as to be more or less unremunerative and of seriously lessened yields in places owing to the sugar-cane having become on them subject to disease to an extent not previously experienced. The area of land, about 72,000 acres, under this crop is practically the same as it was eighteen years ago, while the average crops of sugar-products are somewhat higher. In round figures the colony exports in normal years about 110,000 tons of sugar, 3,600 casks of molasses, 2,500,000 gallons of rum, and 12,000 tons of cattle-food prepared from the refuse-products of the sugar-cane. But if scarcity of labour did not stand in the way of the expansion of the sugar-industry, the colony would be able to

produce many times the quantities of sugar-products for which it is now responsible.

Should any certainty arise of sugar continuing to command, as at the time of writing, remunerative prices, a very great extension of sugar cultivation would take place in the colony. It is estimated on very conservative grounds that the readily available area of land well-suited for the sugar-cane cultivation in the eastern part of the colony could produce 1,000,000 tons of sugar, whilst there is available land suitable for sugar cultivation in the North western portions of the colony to increase this amount to 2½ millions of tons a year.

As in many other sugar-cane producing countries, the sugar-cane in British Guiana has suffered much in late years from fungoid diseases. The Bourbon, which was the best variety cultivated and the source of the far-famed "Demerara Crystals," has either developed a certain tendency to disease or lost to a marked extent the resisting powers to fungoid attacks it once possessed, and thus has fallen off in its yields. When the Bourbon cane first showed signs of tendency to disease, the planters of the colony took the matter seriously in hand, and succeeded in more or less keeping the diseases under control by the adoption of, as far as possible, every precaution that was suggested by the authorities at Kew, or was indicated by their own experience. But they were not as successful as they would have liked to have been, and hence had to resort to attempts to obtaining an equally satisfactory variety from seed, with the result that now more than four-fifths of the area under sugar-cane is in varieties other than the Bourbon.

As far as obtaining varieties which yield more heavily than the Bourbon now does, or which give remunerative crops on land on which that variety has never flourished, these endeavours have been attended with a large measure of success. But a variety which approaches the Bourbon as a source of "Demerara Crystals" has not yet been secured. This sugar does not owe its high reputation solely to the high proportion of sugar it contains, but to its pleasing colour, flavour and especially to its aroma. The first of these has been more or less successfully imitated in "Yellow Crystals" but the latter appear to be unattainable artificially in the perfection which characterises "Demerara Crystals" made from the Bourbon cane. This sugar is a special product of the colony and when made in British Guiana it may be said to be a "vintage" product of the Bourbon cane.

The trials in British Guiana have had for their object securing or producing reliable varieties of sugar-cane from which planters may select kinds to suit their special conditions of soil, rainfall, etc., and this has been more or less successfully accomplished. In the year 1899 only 550 acres were planted in new varieties in the colony, whilst at the present time over 55,000 acres are under them. The records show that certain new varieties of sugar-cane have given over large areas mean results of 30 per cent. higher than the returns obtained from the Bourbon on the same plantations. About 14 per cent. of the area occupied with new varieties are under kinds imported from Barbados, whilst about 85 per cent. are under kinds raised in British Guiana. The most promising varieties up to the present are 208 B. and 147 B., imported from Barbados, and D. 625, Diamond 185, D. 118, and D. 145, raised in Demerara.

The sugar-manufacturing industry has been compelled by economic conditions to become one almost solely for large capitalists and companies. Smaller cultivators pursue the sugar-cane-growing industry with fair success. Cane-farming is carried out to some extent by small proprietors and villagers, and its extension on a mutually profitable basis to the farmers and to the manufacturers is very desirable.

The following tables show the average annual quantities and the values of sugar and sugar-products exported from British Guiana during the quinquennial periods from 1892 to 1911 and the years 1912, 1913 and 1914:—

QUANTITIES.

Period.	*Sugar, Tons.*	*Rum, Proof gallons.*	*Molasses, gallons.*	*Molascuit, Tons.*
1892-6	106,257	2,003,885	100,852	*
1897-1901	96,542	4,062,034	357,201	
1902-1906	116,859	3,535,057	333,366	6,666
1907-1911	104,961	2,939,623	176,288	8,488
1912*	77,788	2,382,937	176,011	5,116
1913*	87,414	3,260,986	118,699	6,860
1914	107,138	3,489,729	83,197	2,427
Mean	99,565	2,925,055	192,242	5,911

* Crops very adversely affected by the prolonged droughts of 1911 and 1912.

VALUES.

Period.	*Sugar.*	*Rum.*	*Molasses.*	*Molascuit.*
	£	£	£	£
1892-6	1,305,989	135,946	24,965	
1897-1901	1,066,376	189,186	11,070	
1902-1906	1,142,284	107,099	11,070	23,679
1907-1911	1,170,399	134,690	11,447	20,300
1912	1,019,490	126,178	7,494	17,145
1913	1,102,670	204,163	5,020	23,490
1914	1,574,615	231,846	4,284	10,246
Mean	1,179,218	147,699	13,449	20,829

The average value of the products of sugar cane exported annually from the colony for the past twenty-three years has been £1,361,195.

In the nineties two-thirds of the British Guiana sugar were exported to the United States and almost one-third to the United Kingdom, only a small quantity going to Canada: whilst in 1912 and 1913 70% of the sugar was exported to Canada, about 20% to the United Kingdom and 8% to the United States.

RUM.

British Guiana has the largest export of rum of all the West Indian colonies, its export of pot-still rums alone being 12 pr cent. higher than that of Jamaica. The production of rum has been the subject of investigation in British Guiana on scientific lines for many years past, and as far as the production of alcohol from the sugars present in the wash (wort) is concerned it has in many estate distilleries been brought to a condition approaching perfection.

In British Guiana rum is produced by a rapid fermentation extending from 36 to 48 hours by setting up a wash of molasses diluted with water at a density of about 1,060. The wash is set up slightly acid, and in some distilleries small quantities of sulphate of ammonia are added to it in order to supply readily available nitrogenous food for the yeast.

The distilleries are of two types, using either pot or vat stills, or Coffey and other continuous rectifying stills. In 1914 there were 27 distilleries of the first type and 9 of

the second. The Coffey or continuous rectifying stills used are of well-known types and are usually built locally, their columns being constructed of colony-grown timber.

Demerara rum is the product of a pure yeast fermentation, and hence does not possess a high flavour like rums of slower fermentation, where wild yeast and bacterial organisms flourish in the wash.

MOLASCUIT.

About a dozen years ago Mr. George Hughes, F.C.S., introduced a process for the preparation from the by-product of the sugar-cane of a high grade cattle food, especially suited for the rapid fattening of beasts. The food consists of a mixture of the finer particles of the interior spongy tissues of the sugar-cane, which is separated from the megass produced during the grinding of the sugar-cane in the manufacture of sugar, with vacuum pan molasses. The mixture results in a dry, brown-coloured, coarse powder possessing a very fragrant and attractive odour. Its special characteristic is the relatively high digestibility of the fibre present in the food. Representative samples have the following composition :—

Moisture	17.3
Fat	.6
Albuminoids	1.5
Sucrose	36.1
Glucose	20.2
Other soluble Carbohydrates	7.3
Digestible fibre	7.6
Woody fibre	2.9
Mineral matter (ash)	6.3
	100.0

The high proportion (72 per cent.) of readily digestible constituents in molascuit is clearly shown in the above. For use as a cattle food it should be fed with an addition of another cattle food, such as cottonseed cake, containing relatively high proportions of albuminoids and oil.

RICE.

This industry is one pursued by small farmers and its development in the colony has been mainly due to the East Indian settlers. The black people in the colony also enter

with some enthusiasm into this industry. The proprietors of sugar estates give every facility in their power to their employees to carry on rice-growing.

The returns made to the Board of Agrculture show the great extension which has taken place in this industry of recent years. In 1898 the acreage returned by cultivators as being under rice was about 6,000 acres: for 1914* it was returned as about 45,000 acres. The increase in the crop of rice between 1809 and 1915 represents about 32,000 tons of cleaned rice per annum, the value of which probably is about £450,000.

The enormous area in British Guiana pre-eminently suitable for the cultivation of rice should enable this colony to become the granary for the West Indian Islands.

The rice generally grown in the colony is a long-grained variety known as Creole rice, and seems to be one which has originated there by unconscious selection. It is of excellent quality equal to any that has been imported into the colony. The choicest strain of the creole rice is that known as the "Berbice." It has been proved that by experimental cultivation we can obtain varieties of equally good quality, but of higher yielding powers.

With this object in view large numbers—over 250—of varieties of rice have been imported into the colony by the Board of Agriculture. Of these varieties three have consistently given better returns than the creole has done, and about 10 tons annually of specially selected seed paddy is being distributed free to numerous growers of the colony. Further selections and crosses are being made year by year and the selected varieties are tried in trial plots against the standard kinds. The results of these experiments are most encouraging. Some of the selected varieties raised during the past few years show, on small plots, marked increases in yields over the standard varieties and are now being tried experimentally over larger areas.

The methods of cultivation generally in vogue are Eastern ones. Nearly the whole of the work is done by hand labour. Primitive ploughs and harrows are employed in many districts and cattle are sometimes used for the trampling out of the grain, while winnowing is usually accomplished by hand. Improvements in the methods of cultivation are being

*As two crops are reaped each year in certain districts the actual area of rice reaped in 1914 was 51.260 acres.

made, and increased returns have resulted. Rice is being cultivated and reaped on a large scale by modern appliances in the Abary district and the venture is full of interest as promising on account of the low costs of production to be very successful.

There are several large rice mills in different parts of the colony whilst there are a very large number of small ones scattered throughout the rice districts. From trials made, it has been ascertained that locally grown paddy gives about 60-65 per cent of its weight of clean rice. Two kinds of rice are made; a brown rice in which the paddy is steamed before it is passed through the mills, and a white rice. Brown rice is more nutritious than the white rice. No polishing of rice is carried out. Ricemeal is made as a by-product and in 1914 240 tons were exported.

The following table gives the average yield of paddy (unhusked rice,) per acre in the colony from 1898 to 1914:—

Period.	*Average yield of padi per acre.*
1898-1902	20.7 cwt.
1903-1907	23.3 „
1908-1911	23.3 „
1911-1914	21.8 „
Mean	22.2

COCONUTS.

Coconuts thrive well on the coastal lands of the colony, especially where the land is more or less of a sandy nature, and expansion of this cultivation is steadily taking place.

The coconut palms growing in the colony are scattered, being owned chiefly by small growers, but there are a few fair-sized coconut estates, whilst extension over large areas is taking place on some sugar plantations. Reefs of light sandy loam exist on the Corentyne Coast, along the East Coast of Demerara, and in Essequibo, where coconuts flourish, and even on the heavier coastal lands they grow satisfactorily and bear very heavily. They do not grow so well nor yield satisfactorily on the pegassy-clay lands and on river lands away from the coastal region.

The area planted with coconut palms has been slowly increasing for some years, but during recent years there has been much greater activity in this direction and the continued extension of the industry may be expected. The following acreage

returns of the Board of Agriculture show the advance that is being made:--

1904-1905	5,140	acres
1905-1906	6,560	„
1906-1907	6,700	„
1907-1908	6,828	„
1908-1909	8,315	„
1909-1910	9,466	„
1910-1911	9,761	„
1911-1912	12,236	„
1912-1913	13,698	„
1913-1914	14,177	„
1914-1915	15,260	„

A very large proportion of the acreage under coconuts in the colony is still young and has not come into bearing.

The exports of coconuts are at present very small in relation to the number of acres in bearing, as the major portion of the nuts yielded by these areas are utilized in the colony for the preparation of coconut oil and of cattle food. There is a very large consumption of coconut oil especially among the East Indian section of the community and the locally prepared product has gradually replaced the imported coconut and other kinds of oil. During late years, however, the exports of coconuts have been increasing. This is due to the enhanced value of coconuts in the world's markets, which has rendered the exportation of nuts somewhat more profitable than the preparation of oil for local consumption.

The following table shows the annual average exports during quinquennial periods since 1892 :—

Period.	*Average Annual Export.*	
1892-1896	80,374	Nuts
1897-1901	21,892	„
1902-1906	187,305	„
1907-1911	526,901	„
1912-1914 (3 years only)	1,427,644	„

Coconuts are chiefly exported to the United States. A small quantity of copra is made in the colony, the export during 1914 being 1,690 cwts. The copra is the ordinary grade used for the extraction of oil and is mainly sun-dried, although attempts are being made at artificial drying.

The majority of the coconuts produced are used for the manufacture of oil for local consumption. For obtaining the oil, open coppers for boiling the grated coconuts are generally

used and the returns are not as high as they should be. There are a few oil factories in the colony.

COFFEE.

In the earlier part of the last century, British Guiana, and especially the county of Berbice, was celebrated for the high quality of the coffee it produced. Unfortunately, about the time of the cessation of slavery, circumstances beyond the control of the planters necessitated the gradual abandonment of the cultivation.

At the present time about 3,800 acres are occupied in coffee-cultivation, a large proportion of the product being consumed locally. Two kinds of coffee are cultivated in the colony, the Arabian or so-called creole kind, and the Liberian variety. Both sorts grow with exceptional vigour, and the former is singularly free from disease.

Large areas of low-lying land in British Guiana are ideally suited to the growth of Arabian coffee. The meteorological conditions of these parts of the colony are very similar to those of the higher parts of many of the West Indian Islands, and when this is borne in mind the excellent way in which coffee grows on them ceases to be surprising.

It is greatly to be regretted that local conditions, especially scarcity of available labour, tend to restrict the extension of the area under cultivation and that the usually low price of coffee does not offer much inducement for small capitalists to take up its cultivation.

The Liberian variety grows very well indeed in many parts of the colony, and wherever it flourishes it is very prolific: in fact, at times the difficulty is to restrain its bearing propensities sufficiently to prevent the tree permanently injuring itself. It is, however, on the wind-swept parts of the coastlands more adversely affected by unfavourable meteorological conditions than is the Arabian kind. But this is not the case at some distance back from the coast-line and on the lands along the lower reaches of the rivers.

The annual exports of coffee during recent years may be seen from the following statement :—

1907	.. 2 cwts.	..	1911	1,225 cwts.
1908	190 „	..	1912*	727 „
1909	.. 1,122 „	..	1913*	727 „
1910	.. 978 „	..	1914	2,132 „

*Crops affected by the prolonged drought of 1911 and 1912.

CACAO.

Cacao-planting is an industry of some promise in parts of the colony, but unfortunately it requires for its successful installation command of more capital than small farmers usually possess. Cacao requires for its satisfactory growth land well-drained to the depth of from three to five feet, and on land of this sort it does very well indeed. There are great areas of land a few miles up the lower reaches of the rivers where good drainage can be easily ensured and upon them cacao flourishes. It is to be regretted that persons with command of sufficient capital and with knowledge of the cultivation of cacao have not taken up its growth in these parts of the colony to a greater extent than has been done.

Some of the cacao estates are of fair age, but there are also considerable areas under young trees that have not yet come into bearing. The Government have an experimental area of cacao at Onderneeming, Essequibo, where from selected trees of high yield and good quality seeds are obtained for propagating purposes and increasing numbers of promising cacao seedlings are being supplied at low cost. Systematic experiments with cacao were commenced at Onderneeming in 1900. They have proved of value to the cacao cultivators in the colony by indicating that largely increased yields are obtainable by the reduction of the shade trees to the minimum necessary for protection of the cacao trees against wind; that large increases in yield result from heavily mulching the trees; and that the most profitable applications of artificial manures are of mixtures of sulphate of potash and superphosphate of lime, to which additions of nitrogenous manures are seldom remunerative; whilst nitrogenous manures, *per se*, tend to reduce the bearing powers of the trees.

The acreage under cacao cultivation during recent years is as shown below:—

1907-08	.. ..	1,832 acres
1908-09	.. ..	2,181 "
1909-10	.. ..	2,223 "
1910-11	.. ..	2,016 "
1911-12	.. ..	2,127 "
1912-13	.. ..	1,983 "
1913-14	.. ..	1,863 "
1914-15	.. ..	2,316 "

The decreases in the area returned as cultivated in cacao in the years 1912 and 1913 were attributed to the drought of 1911 and 1912 and to the abandonment of cacao in some cases for rubber cultivation. Practically only the Forastero variety is grown in British Guiana, other sorts being cultivated only to a very small extent.

At present therefore only about 2,000 acres are planted in cacao; their yield is mostly used for the local demands of the colony, and thus the export is small, not more, as a rule, than from 750 to 900 cwts. per annum. That exported brings a good price owing perhaps to the great care which is exercised in fermenting and curing the beans.

On some plantations kola-nuts are grown among the cacao producing a small yearly export of about 40 cwt. Among subsidiary products which do well wherever cacao and kola flourish, nutmegs occupy a prominent place.

RUBBER.

There are in British Guiana five indigenous species of Sapium, two of which yield rubber of marketable quality. The cultivation of neither of these species has, however, been successful owing to the low yields obtained from the trees.

All the sapium rubber exported in previous years from the colony as "Orinoco scrap" was derived from the wild forest trees.

Since 1907 some interest has been shown in the cultivation of Para rubber, there being now about 4,050 acres under cultivation in the colony. The increase in area will be seen in the following table:—

Year.	*Area.*	*Increase.*
1907	410 acres.	
1908	550 "	140 acres.
1909	1,000 "	450 "
1910	1,740 "	740 "
1911	2,260 "	520 "
1912	3,140 "	880 "
1913	4,000 "	860 "
1914	4,040 "	40 "

Companies formed for the cultivation of Para rubber hold the greater part of the land at present under cultivation, some 10,780 acres of Crown lands having been leased for this express

purpose. The trees are young and tapping on an extensive scale has not commenced. It is, however, anticipated that within a year tapping on an appreciable scale will be carried out by at least two of the companies at present engaged in the cultivation of Para rubber.

On suitable land the growth of the tree is not less rapid than it is in the East, while recent trials at the stations of the Department of Agriculture and on some private properties indicate that a yield of dry rubber per tree as good as that obtained on the best Eastern plantations is to be anticipated. The cost of collection of the rubber from a block of 400 trees at one station indicates that a reasonable profit can be expected with the market value of the product at 2/- per lb. The good health of the labour force, the low cost of supervision on estates and the proximity of the colony to the United States of America are factors which should encourage the extension of this industry in the colony.

LIMES.

" Limes grow well on the lighter soils of the colony if they are protected from the full force of the wind. On the light, almost sandy soil of the Essequebo Coast they grow excellently, as also on the laterite soils of the Essequibo river. In the interior of the colony lime trees flourish around the various settlements, where they bear large crops of excellent fruit.

There are very large areas of loose, friable land that are well adapted to the cultivation of limes, whilst there is an enormous extent of ferruginous lateritic soils in many parts of the interior of the colony on which this crop can be successfully grown.

British Guiana should become one of the most important producers of limes and lime products in the world. The lime trees when well tended are generally free from diseases and insect pests, and the cultivations show signs of satisfactory progress.

The limes produced are juicy fruit, and their acid content is satisfactory. There is no difficulty in obtaining fruit for seed purposes and seed selection is now being paid attention to. Seedlings are readily raised, and after planting out need little attention if cultural and weeding operations are carefully carried out.

There are in the colony at present about 1·000 acres under limes: this area belongs mainly to two companies.

COTTON AND OTHER FIBRES.

The climate of the coastlands of British Guiana and the heavy nature of their available soils are not favourable for the successful growth of Sea Island or even of Egyptian cotton with commercial success. There are, however, several varieties of cotton in the colony which have been growing there for generations and which may now be regarded as practically indigenous. In the earlier years of the last century cotton obtained from these varieties formed a very important export from the colony. The cottons are perennial tree cottons and grow with great vigour, being apparently able to withstand the erratic meteorological conditions which sometimes prevail on the coastlands and which are detrimental to the yields of all varieties hitherto introduced. The lint is short-stapled and is of about the same quality or somewhat better than rough Peruvian, worth 6d. to 9d. per lb. The price is not sufficient to induce the cultivation of the cotton on an extensive scale. It is probable, however, that an impetus would be given to the cultivation if agencies for the purchase of the cotton in small quantities were established in the country districts.

Experiments in hybridisation have been in progress since 1908 by the Department of Agriculture having in view the production of a heavily bearing perennial variety yielding lint of the Sea Island type and there are indications that the objects of these experiments are being attained.

Among other fibres which offer promise for successful cultivation is the Ginger Lily, *Hedychium coronarium*. This is met with growing untended along the banks of some of the rivers on land containing fair quantities of organic matters, and a growth is there attained quite equal to that reported from Brazil. On the front lands of the colony on the heavy soil the plant does not make such good growth. Its experimental cultivation has been commenced by the Board of Agriculture both at the Botanic Gardens (coast) and at one of the Agricultural stations situated on the bank of the Aruka river, (North Western District). In the former experimental cultivation the green weight of the stems and leaves obtained from a first crop six months after planting was equivalent to 22 tons of the raw material per acre, while a ratoon crop equivalent to 27 tons per acre was obtained six months later. A heavy third crop is now on the land. The stems and leaves as cut gave one-eighth of their weight in dry material suitable for baling for shipment. The results of the latter experiment,

which is being carried out on a larger scale, are not yet available.

CATTLE RAISING.

There are very large areas on the coast lands of the colony which are well adapted for the pastoral pursuits especially for cattle-raising. At present there are about 90,000 head of cattle in the colony. About 600 head and a small number of hides—4,500—are exported annually.

Reference has been made to the very extensive savannahs of the far interior of the colony; upon these great development may take place in cattle-ranching for which they are reported by all who have visited them as specially well-adapted.

On the savannahs are scattered areas of well-watered fertile land on which the rancher can raise all kinds of tropical field and garden produce that he may require.

FUTURE EXTENSION OF AGRICULTURAL INDUSTRIES

The sugar industry is by far the most important industry of the colony, and sugar with its by-products rum, molasses and molascuit contribute almost 75 per cent. of the total value of the exports. About 33 per cent. of the wage-earning portion of the population are directly connected with the sugar industry, while if those indirectly connected are included the proportion is in excess of 50 per cent. of the population.

44.7 per cent. of the empoldered area of the colony is under sugar cultivation. About 85% of this is reaped each year. This indicates that in round figures 38% of the empoldered land contributes to the yearly production of sugar. The average production of sugar over the colony during normal years is about 1.8 tons of sugar per acre. On well administered, suitably equipped and satisfactorily financed plantations the average yield in fair years may be taken as 2.10 to 2.20 tons of sugar per acre per annum.

A conservative estimate of the area of land well suited for sugar cultivation in the districts from the mouth of the Pomeroon in the north-west to the west bank of the Corentyne river in the east is 531,000 acres exclusive of the area already empoldered on sugar estates. Sixty-four thousand acres of this may be already beneficially occupied by products other than sugar leaving nearly 470,000 acres available for the extension of sugar cultivation. At the present proportion of land yearly cropped with sugar to the total empoldered area this would

give in round figures 178,000 acres to be reaped each year yielding a mean crop of 320,000 tons of sugar.

Given sufficient capital, labour, progressiveness and enterprise, the colony's sugar crop on its eastern area could be increased to 570,000 tons of sugar per annum which by fully applying modern scientific methods in cultivation and manufacture might be raised to 700,000 tons. Inclusive of the vast north-western section, on the coastlands and along the lower reaches of the rivers of British Guiana the total area of easily accessible land presumably well-suited for sugar cane cultivation and at present not otherwise beneficially occupied amounts in round figures to 1,620,000 acres. This area if fully planted and reaped under modern conditions of cultivation and manufacture could yield from 2⅛ to 2½ millions of tons of sugar per annum.

PARA RUBBER.

Very large areas are available in the colony for rubber cultivation. The growth obtained by rubber trees has demonstrated that there are large tracts of land adjacent to the Demerara, Essequibo, Pomeroon and Berbice rivers and in the North-Western District which are pre-eminently suited for the cultivaton of Para rubber. It has been proved that the cost of collecting the product is reasonable. These facts indicate that extension of this industry in the colony should meet with much success.

LIMES.

There are wide areas of land available and very suitable for the cultivation of citrus fruits. The growth attained by trees planted on the light lands of the lower reaches of the Essequibo river fully justifies an extensive cultivation of lime trees in the colony.

COCONUTS.

This product is suitable for cultivation over large areas in the low lands of the colony. Local varieties of coconuts yield very heavy crops of medium sized nuts on relatively heavy clay soils on the coastlands, whilst on lighter lands similar varieties produce much larger sized nuts. There can be no doubt that the colony is emphatically a coconut land and that there are in it practically unlimited areas of land very suitable and readily available for coconut cultivation.

RICE.

Great extension of the lands under cultivation with rice may be expected in the near future. There are hundreds of

thousands of acres of land exceptionally well suited for its growth awaiting development.

CACAO, COFFEE, KOLA, FRUITS, ETC.

There are plenty of openings for the development of plantings of these products, the best of which perhaps are the lands bordering both banks of the Berbice river along its course from about 30 to 150 miles from its mouth.

FOREST RESOURCES.

These are practically illimitable; their utilisation, however, is checked by difficulties of transportation in the interior of British Guiana.

BALATA.

The trees from which balata is obtained are found growing all over the colony particularly on the lower but not swampy lands along the banks of the smaller rivers and creeks. They are perhaps most abundant in the county of Berbice, where the balata collecting industry has been established for the past fifty years.

The collection of balata is carried out under licences issued by Government. For the purpose of the administration of balata collection the colony is divided into sections of 50 or 250 square miles in area, the former in the more readily accessible and the latter in the less readily accessible parts of the colony. A separate licence is issued for each section and confers the right to collect wild rubber as well as balata. The terms are for not more than 15 years, an application fee of £1 13s. 4d. and an annual rental of £4 3s. 4d. for each licence, and a royalty of 1d. per lb. on all balata and wild rubber collected. The licences are issued for collecting only and may be cancelled if the land is required for agricultural or mining purposes. The collection is carried out by Negroes and Aboriginal Indians who are registered as bleeders. No tree is allowed to be bled which does not measure 36 inches in girth at 4 feet from the base. Trees may be bled on one-half of the circumference only at any one time. No tree is allowed to be re-bled until 5 years have elapsed from the previous bleeding. The cuts employed for extracting the milk must be not more than 1½ inches wide and not closer together than 10 inches.

The collectors proceed to the grants from January to April and the work generally commences towards the end of May and extends to the beginning of October. The collectors are paid by the weight of balata obtained.

Bleeding is done by means of a cutlass; the incisions are 10 inches apart and are arranged in a feather-stitch pattern. Bleeding is commenced at the base of the tree and extends to the main fork; the branches of trees are seldom bled. The milk is collected in a calabash (made from the fruit of *Crescentia cujete*), placed at the bottom of the tree and held fast by inserting its lip between the bark and wood of the tree. The first bleeding is done while the collector is standing on the ground;: the parts of the trunk situated higher up are bled by the aid of a ladder roughly constructed in the forest, while the highest parts are frequently reached by the aid of a rope for climbing.

The latex is transferred from the calabashes to kerosene tins and taken to the camp where it is poured into a shallow tray (dabree) and allowed to evaporate. This tray is constructed generally of pieces split from the stem of a palm. The latex coagulates by evaporation and the gum is removed in successive sheets from the top to the bottom.

The yield varies up to certain limits according to the age and size of the tree. Speaking generally, five pounds of dry gum per tree is considered a good yield.

Recent investigations have shown that the yields obtained by bleeding standing trees with cuts arranged in the feather-stitch pattern are not less than those obtained by first felling the trees and then extracting as much latex as possible by completely ringing the bark and this fact has prevented the ruthless destruction of the tree which is valuable for its timber as well as for its production of the gum.

The following table shows the export of balata in five year periods since 1893:—

Period.				*Total.*
1893-1897	..	..	..	1,133,123 lbs.
1898-1902	..	..	..	2,009,785 „
1903-1907	..	..	..	2,488,951 „
1908-1912	..	..	..	5,376,059 „

The exports go chiefly to the United Kingdom, the remainder going to the United States of America and to Holland.

The export of balata from the colony for the year 1913, was 1.323,609 lbs. of the value of £160,000. Owing to the war closing some of the more important European markets, the export for 1914 fell to 1,022,750 lbs.

As the balata tree occurs in large quantity in the forests of the colony, providing the gum continues to realise its present market value, there is the prospect of the balata industry continuing to flourish for many years to come.

RUBBER.

From time to time small quantities of wild rubber are collected in the forests from the indigenous rubber yielding species of *Sapium*. The rubber is of good quality. It is usually classed on the market as "Orinoco Scrap," and if clean fetches fair prices. Small quantities of soft inferior rubber also are yielded by indigenous varieties of *Hevea*, but there is very little chance of any development in the collection of rubber from indigenous trees taking place.

TIMBER.

The forests of British Guiana cover some 78,000 square miles of country or about six-sevenths of the whole area of the colony. The forests extend throughout the whole colony but are broken at intervals by areas of savannah land. At present the workable area is confined to 11,000 square miles in the more readily accessible parts extending from the sea coast to where the courses of the large rivers, beyond their tidal reaches are interrupted by cataracts, rapids and falls. Timbers having a higher specific gravity than water cannot be transported by water carriage over these obstacles. Therefore the utilisation of the practically illimitable forest resources of British Guiana is checked by great difficulties of transportation. There is little doubt that an enormous development of the timber industry would follow the institution of transport facilities by a railway to the interior of the colony.

The trees composing the forests of British Guiana are rarely of social habit. Many different kinds of trees exist in any one area and the forests are of the class termed "mixed." The forests vary in height. On the low coastlands and along the tidal reaches of the rivers the average height of the trees would be about 60-70 feet, but further inland they are more lofty and are on the average about 100 feet in height. As a rule the trees in the high forest rise with straight clean stems and are of small girth.

In parts of the forests it is usual for various kinds of trees to predominate and to form more or less broadly defined natural divisions of forest growth. These are known locally by the name of the prevailing kind of timber as the green-

heart, wallaba and crabwood forests. Frequently the predominance of different kinds of timber is confined to situations defined by the nature and condition of the soil, and thus the natural divisions of forest growth are accentuated by differing conditions of soil, and topographical features.

The following industries are carried on at present in connection with the forests of the colony:—

Woodcutting for (a) Timber and lumber.

(b) Wallaba shingles, paling staves, and posts.

(c) Charcoal.

(d) Fuel.

Labourers for transportation or general work are engaged in these industries under contract for periods up to three months at a daily wage. For felling trees and squaring timber trained wood-cutters are required and are paid at an agreed rate per cubic foot of the timber squared where felled. All hauling is done by gangs of men or by oxen, and the greater portion of the timber is floated down the rivers to convenient points for export.

The following are notes on the more important commercial timbers:—

Greenheart is commercially the best known of all the timbers of the colony. Large quantities have been regularly exported for many years. It is rated as a first class wood at Lloyds and it is chiefly used for submerged works such as wharves, piles, dock and lock gates.

The brown or yellow greenheart is hard, heavy, tough, strong and elastic and is said to have the property of resisting the Teredo. The black variety is much scarcer. It can be distinguished from the brown variety by its colour and greater hardness. Logs of greenheart can be obtained from 10 to 25 inches square, and up to 65 feet in length.

In habit the greenheart is partly gregarious. It favours hilly land with a sandy clay soil, and is usually found more abundantly on the slopes of the hills. The greenheart areas are estimated to contain an average of thirty-two greenheart trees to the acre and are almost entirely confined to the central parts of the colony which are traversed by the Essequibo, Demerara and

Berbice Rivers and their tributaries. There is a large quantity of this wood in the interior regions waiting easier means of transport for exploitation.

Crabwood.—There are two varieties of West Indian Mahogany (*Carapa guianensis*), locally termed crabwood, the red and the white. The red is a red coloured wood, with a moderately coarse and open grain. It is largely used in the colony for building purposes and is the most popular furniture wood. It resembles Mahogany in appearance when polished and has proved itself to be a good substitute for that wood. The white is similar in structure to the red variety but paler in colour and of less specific gravity. Logs of this wood can be obtained from 40 to 60 feet long, and from 10 to 16 inches square.

The wood is found growing scattered throughout the forests of the river valleys of the colony, particularly on low lying flat lands subject to inundation either by high tides or heavy rains. It also occurs in lesser quantities in the more elevated country.

Wallaba—There are several varieties of this wood; those principally used are "Soft Wallaba" (*Eperua falcata*) and "Ituri Wallaba" (*Eperua Jenmani*). The heart-wood of these varieties is in great demand for posts and for making shingles, palings, vat staves, etc. Wallaba is a heavy, hard wood, with a very coarse but more or less even grain. It splits readily, is very resinous, and has an unpleasant smell which, however, disappears after a sufficiently long exposure. It is probably the most abundant of the colony's timbers.

On the slightly elevated and hilly lands of loose white sand situated in the central and eastern parts of the colony the Wallabas constitute about 40 per cent. of the forest trees. In the forests of the swamp lands the two kinds abovementioned together with "Bimiti Wallaba," which is only used for fuel, are found on places where the soil is more or less of a sandy nature.

OTHER WOODS.

In addition to the above mentioned woods there are many other valuable woods, of which at times some are exported in small quantity.

Hard woods.—The following hard woods may be mentioned: —Mora (*Dimorphandra Mora*) rated first-class at Lloyds, and used for railway sleepers. It grows near to the banks of the rivers and creeks, is of large size and is useful for many

purposes. Bullet Tree (*Mimusops globosa*), is now cut only by permission for special purposes, it being the source of balata. The wood is dark red, close-grained, heavy and durable. Surandanni (*Hieronima alchorneoides*) grows in low situations and is fairly plentiful. The wood is of a deep red colour. Purple-heart (*Copaifera publiflora*) is one of the tallest trees of the forests. The wood is a dark purple colour and is hard, close-grained and durable. Locust or Simiri (*Hymenoca Courbaril*) grows in sandy soils. The wood is hard, heavy and close-grained, and takes a fine polish.

Other hard woods of local commercial value are Hackia (*Sidcrodendron triflorum*). Towaronero (*Humiria balsamifera*), Kakaralli (*Lecythis corrugata*), Tonkin bean or Kumara (*Dipteryx odorata*), Hiawaballi (*Omphalobium Lambertii*), Kabukalli (*Goupia glabra.*) and Phokadie (not identified.)

Soft-woods—Silverballi or Siruaballi (*Nectandra spp*), of which there are several varieties, the Yellow, Brown, Keritee, Yekuru and Mainap, are all handsomely grained woods with an aromatic scent. They are durable woods and are used principally for planking boats and for making knaves of wheels. Determa (*Nectandra sp.*) is well adapted for making corials and canoes and for masts and spars of vessels. It is a light, strong wood. resembling cedar in colour. Soft woods of local commercial value are Hooboballi (*Mimosa guianensis*) Arrisouroo (*Pterocarpus guianensis*), White Cedar (*Tabebuia longipes*), and Red Cedar (*Protium altissimum.*)

Very Soft Woods.—Simarupa (*Simaruba officinalis*), grows throughout the colony specially on sandy soils. The wood is of light colour and is close-grained. It is useful for inside house work. Dalli (*Myristica surinamensis*), and Photee (*Jacaranda Copaia*) occur in fair quantities and are used for lumber, making match boxes, etc.

Charcoal Burning.—This industry is principally carried on where the lands are of a sandy nature on the Demerara and Berbice Rivers. The wood is converted into charcoal by burning it in covered pits dug in the sand, in which the wood is packed with the coarser material in the middle. All kinds of wood, and all parts of the trees are used. The charcoal is largely exported to the Southern West Indian islands.

FIRE WOOD.

On the sea coasts Courida (*Avicennia nitida*), is much used as a firewood. On the river lands all kinds of woods are cut for

fuel, but Wallaba is mostly favoured, as it splits readily and burns well. Practically all the firewood exported is obtained from the lower Demerara River, whence it can be transported cheaply for shipping to Barbados and other West Indian islands.

EXPORTS OF TIMBER PRODUCTS.

The Colony annually exports about 250,000 cubic feet of timber, 80,000 bags of charcoal, 8,500 tons of firewood, 250,000 feet of lumber and 2,500,000 wallaba shingles These exports have a total average value of £37,000 a year.

GUMS, OILS, RESINS, ETC.

Small quantities of gums are collected and exported. Gum Animi, a product of the locust tree (*Hymenoca Courbaril*) is exported in small quantities. At one time there was a good demand for this product but not much has been exported of late. The fossil gum resembles amber in appearance and is often found in blocks of considerable size.

Hiawa gum or Resin of Conima used for incense is obtained from *Protium heptaphyllum*, a tree common in all localities of the colony, and can be had in considerable quantities.

Tonkin beans are collected and exported. They are the yield of the Kumora or Tonkin bean tree, a large tree growing plentifully in localities above the rapids and in the upper islands of the Essequibo River and its tributaries.

Souari nuts (or Butter nuts), the product of *Caryocar tomentosum* are also collected. The Souari nut tree is one of the giants of the forest and thrives best on hilly lands of a clayey nature. Trees under cultivation at Onderneeming Experiment Station have fruited in six years from planting.

The seeds of the Carapa, or Crabwood, are collected and from them the well known "Crab-oil" is obtained. The greater proportion of this oil offered for sale is manufactured by the Indians.

It is very evident from the foregoing that British Guiana is a land of vast potentialities only limited by lack of transport facilities, labour and capital. It is reasonable to expect that provision of quick and cheap means of transport such as would be supplied by railways traversing in various directions the interior of the colony would be quickly followed by an influx of labour and of capital by which the great resources of the colony would be rapidly developed.

The Cultivation of Limes: I.

By Professor J. B. Harrison, C.M.G., M.A., Director, and C. K. Bancroft, M.A., F.L.S., Assistant Director, Department of Science and Agriculture.

An article on lime cultivation was published in this Journal (Vol. IV. No. 1 of July, 1910), and was reprinted by special request in the following number in October of the same year. The cultivation of limes on a large scale in the colony was then a recent undertaking, the two large plantations Agatash, Essequibo, and Providence, Berbice, being in the making. It has been considered desirable to re-write the article, including data which have more recently been acquired, so that the information relative to the subject of lime cultivation might be brought up to date.

HISTORICAL.

The lime of British Guiana and the West Indies is confined to tropical and sub-tropical countries. It is not a native of the Western Tropics but was introduced to the West Indies from India, where it is said to be indigenous to the hot regions situated at the foot of the Himalayas. The date of introduction of the plant is not known, but mention is made of its occurrence in Jamaica at the end of the 17th century. The plant probably found its way to the British West Indian Islands from Martinique. Towards the middle of the 19th century the cultivation of the plant was commenced both in Dominica and in Montserrat. More particularly in the former island the lime industry has considerably increased in recent times, and has also been extended to St. Lucia, Trinidad, Antigua, Cariacou and British Guiana.

BOTANY OF THE PLANT.

The cultivated lime is *Citrus medica, var. acida*, of which there are two varieties, the 'common' or 'spiny' and the 'spineless.' The former is the original plant and is the one more extensively cultivated. The latter is of comparatively recent origin, its first record extending only back to 1891, when it was collected and sown by Mr. Green, Curator of the Botanic Station, Dominica.

The common lime is a tree of medium height, attaining 24 feet when fully grown. The leaves are oval with a serrated margin and possess a distinct petiole which is naked or slightly winged. The flowers are small, white, with a characteristic

perfume, and arise in small groups in the axils of the leaves on the young branches. The tree under suitable conditions flowers freely. The flowers are hermaphrodite; the calyx and corolla lobes number 5 to 7 and the stamens about 20. The fruit is globular and one to two inches in diameter, green when young and yellow at maturity, its wall containing numerous oil sacs and enclosing a pulp rich in acid juice.

The spineless lime is a chance variety arising by mutation, whose characters have been partly fixed by careful selection, about 75% of the seedlings obtained from seeds of spineless limes being without spines. The leaves differ in shape from those of the common lime and the fruits are small and possess a smooth, thin skin and comparatively few seeds. The fruits are very juicy and the juice is said to be purer and richer in acid than that of the common lime. The plant when young is said to be more erect in habit than the common variety.

Whether the spineless lime is in any way preferable to the common lime for planting is a matter of doubt. The plant possesses an advantage in having no spines, thus enabling weeding, cultivation, etc., to be carried out with less difficulty. Its fruits, however, are small and there is no reliable evidence that it is a heavier bearer than the common variety; and it is doubtful whether an alleged somewhat higher acid content of their juice compensates for the small size of the fruits.

Seedless varieties have been noticed in Trinidad, Dominica and Montserrat. These are, however, of little value to the planter owing to the difficulty and cost of propagating them. The cultivation of either the spineless or the seedless variety cannot be recommended for British Guiana.

CLIMATE AND SOIL.

The lime grows best in tropical and sub-tropical regions where the maximum and minimum temperatures oscillate between 90° and 60°F. In Dominica it thrives from sea level up to an altitude of about 1,300 feet. Flat or slightly undulating lands are, however, considered to be the most suitable for its cultivation. A rainfall of from 80 to 115 inches per annum appears to be most suitable for lime cultivation. A fairly even distribution of rainfall is required, without excessive precipitation during the flowering season. Given the latter condition, the lime is successfully cultivated in districts having a rainfall as high as 150 inches per annum. Lands characterised by rich light soil and protected from the wind yield the most satisfact[illegible] growth of limes. The plant grows well on the light, sandy [illegible] of the Essequibo Coast and thrives on the red lateritic [illegible]

many parts of the interior of the colony. On the heavier clay soils near the coastlands of the colony the plant is difficult to establish and the cultivation requires more careful attention and is relatively costly. Speaking generally, the lighter soils of the colony are very suitable to the growth of the plant. The lands most eminently suited to lime cultivation in the colony are rich, light, undulating areas well sheltered from the wind. Such soils are of fairly constant occurrence on the banks of the Berbice river.

PREPARATION OF THE LAND.

The land selected for a lime plantation may either be virgin forest land or secondary forest, or land previously under cultivation in another crop. Land cleared from secondary forest is almost invariably characterised by a thick, almost intractable growth of undesirable weeds, so that the expenses of keeping the cultivation clear are apt to be far in excess of those on land cleared from primeval forest.

The lime does not grow satisfactorily when exposed to strong wind; the trees become stunted and large numbers of flowers are blown off when the trees are in flower. In clearing forest land the tops of hills should not be bared of bush, but should be left to form protective belts. Lines of wind belts, about 2 chains wide, should also be allowed to remain on the plantation. On flat lands exposed to wind, belts of quick-growing trees must be established early. For this purpose any of the following trees may be employed:—Oronoque (*Erythrina glauca*), Pyrowo wykee (*Inga ingoides*), Malacca apple (*Eugenia malaccensis*), Pimento (*Pimenta officinalis*). The first-named is in more common use in the colony than any other tree for shade purposes. It is necessary to plant the trees close together and to keep them trimmed so that they form a dense growth.

The plantation should be laid out in blocks, preferably of 50 acres, either square or rectangular, so as to render the control of cultural operations more easy. A central position should be chosen for the buildings, factory, etc. On a large estate of 500 acres or more it would be more convenient to place the ranges on different parts of the estate so as to enable the labourers to commence work early. Roads should be carefully outlined at the beginning, if they are required, as the produce is bulky and requires to be handled cheaply, or if transport is to be done by water, the positions of navigation trenches should be carefully chosen.

Drainage requires careful attention and it should be well established before planting is commenced. Light land may possess in great part natural drainage. Hilly slopes will require

a system of contour drains to prevent loss of the surface soil through the wash. The drainage should be both early established and effective, as on it the success of the cultivation will in great part depend. The system of spiral contour drains suggested in 1895 by the senior of us for plantations in Grenada, should be employed. In this the contour drains run around the hill in a gradual ascending spiral, short communicating drains between one drain and the next one above it being placed at gentle angles here and there as required. In draining a hill side the same plan should be followed with the exception that the drains should connect with each other at the ends. Paths are constructed when the drains are being dug by throwing the earth from the drains on the outer side.

SEED BEDS.

The raising of seedlings should be given early consideration. These may be established in nursery beds. Planting of seed at stake has been attended in some places with satisfactory results, but it is recognised that the transplanting of carefully selected seedlings is the safer method to adopt.

The seed-beds will require careful preparation. They should be made on flat land in light rich soil or should be carefully prepared with sand, leaf-mould and well decayed pen manure. If the soil is very heavy it may be advisable to germinate the seeds in boxes in soil prepared from two parts earth, one part of sand and one of leaf-mould or manure.

Seeds should be selected for planting purposes from healthy, good-bearing trees. They should be well washed on a sieve so as to get rid of all of the mucilage before sowing in order to prevent rats and other animals from destroying them. They should then be dried in the shade.

The seeds should be sown in rows about 8 inches apart in drills 1 inch deep, the seed being sown thinly in the open drill and then covered over. From three to five feet is a good width for a seed bed. Germination takes place in from 15 to 20 days. When the plants are 4 to 6 inches high they are ready to be transplanted into nursery beds. The plants are carefully lifted, their rootlets trimmed and the stems are topped. They are then removed to the nursery beds where they are planted. The seedlings can generally be transplanted when they are six months old. A careful selection of seedlings should be made with a vigorous rejection of ill-grown ones.

PLANTING.

The land should be prepared and well-lined. On good flat land the rows should be not closer than 20 feet. What the best

planting distance is, is still a matter of doubt. In the West Indian Islands 15' x 15' is said to be the usual planting distance on good flat land, while on hilly slopes 12' x 12' or 14' x 12' is a common distance. This, however, is too close for the vigorous growth of the trees in this colony; there is no doubt that 20' x 20' should be a minimum planting distance on good land ; while on steep slopes the trees may be planted 16' x 16' apart.

Holes 18 inches square by 18 inches deep should be opened to receive the plants. They should be allowed to remain open for some time and then filled in with thoroughly broken up soil. When the land is ready for planting the plants should be lifted from the nursery with forks. In Dominica they are transplanted to the field when they are 16 to 18 inches high; but the experience in this colony is that the plants should be allowed to grow taller, 24 to 30 inches. The roots should be lightly trimmed so as to remove all injured ones. Care should be taken to avoid an undue amount of exposure of the plants to the sun before they are transplanted and the planting should be carried out at the same depth at which the plants were growing in the nursery.

The best planting month in this colony is April or May, but planting may be carried out in other parts of the year except in August to November when the weather is invariably dry. The seeds must, therefore, be sown at a time which will allow of the seedlings being planted in good season. The use of stumps, two years old or more, for planting purposes has been found successful. They should, however, not be too large (more than ½ inch in diameter) as in this case they tend to give rise to a large number of branches and thus to make trees of undesirable shape. In any case stumps require more care in trimming during the early stages of their growth than do selected seedlings from the seed beds. Well shaped trees are an important asset to the profitable cultivation of limes.

CULTIVATION.

Lime trees may give a few fruits in the third and sometimes even in the second year, but it is generally recognised that full crops cannot be expected until the trees are eight or nine years old. It is, therefore, possible to raise crops of cassava, pigeon peas or provisions between the lime trees. If this is done, care should be taken to avoid planting these crops too close to the lime plants, or so thickly as to injure them. It is a common practice in this colony with cultivations of products similar to limes, and one which has much to recommend it, to give out portions of a cultivation free of rent to small

farmers who are allowed to grow provision crops on the land providing that they keep the cultivation clean of weeds. This is a plan which should be encouraged in establishing a lime cultivation; but it is necessary to enforce a rule that the provisions are not planted closer to a lime plant than six feet. It is also advisable to allow not more than two crops of provisions to be taken off the land. The lime tree possesses an extensive surface root system and while for the first year or two the plants will benefit by being kept clean of weeds and also by the tillage of the land in the cultivation of the catch-crops, it is certain that their growth will be retarded by the presence of the catch-crops after the second or third year. The cultivation of root crops or other crops which require to be dug up should not be practised on hilly slopes, but should be confined to flat land, as digging loosens the soil and a considerable amount of wastage by rain-wash takes place. It is well recognized that on hilly lands an attempt should be made to encourage a sod. Grass and low-growing, creeping weeds should be allowed to grow, and where there is any difficulty in this direction cover crops of low-growing plants should be sown. When the "sod" has become established a gradually increasing area should be kept clean around each tree as it develops.

Native low-growing weeds and creeping plants which will repay encouragement are *Desmodium*, *Abysicarpus vaginalis*, *Ipomoea sp*, *Phaseolus semierectus*, Withers' *Phaseolus*.

In new clearings made from original forest grass is slow to establish itself, while bush grows rapidly. The latter should be kept down or otherwise it will kill out the grass and low-growing weeds, and when cleaning is carried out the soil will then become exposed to the full rays of the sun and to the wash of the rain.

The encouragement of creeping plants by cutlassing the bush down to the level of the creepers, broadcasting the seed of the creepers on areas where they are scarce, coupled with the cleaning of a circle of land around each tree, has given good results on one plantation in the interior of the colony opened up from virgin forest land, and can be recommended for lime cultivation under similar conditions.

Mulching should be continuously carried on, and wherever any bush or weeds are cut down they should be placed around the trees in an encircling ring. The distance of the ring from the base of the stem should be roughly the same as the distance of the outermost branches from the trunk of the tree. *Mulch should never be piled up around the base of the tree;* this, as

also the piling up of earth around the collar of the trees does much to encourage the development of what is known as "collar-rot" or 'gummosis.' When a lime plantation is newly opened up, and for a period of some years afterwards, an abundance of material for mulching can be obtained from the weeds growing in the cultivation itself. As this gets older, however, it may be necessary to cut material for mulching from lands adjacent to the cultivation. It is becoming generally recognised that the humus content of the soil should be kept up by the addition of constant supplies of organic matter, and mulching is a practice which is generally increasing in favour.

The question of periodic tillage is one which requires some consideration. Where limes are growing in heavy clay soil forking at intervals should do much towards encouraging their growth. This, however, is expensive and should have been avoided in the first instance by selecting more suitable land for the cultivation of the plant. Forking on heavy land costs $15 or more per acre. The question of tillage is one which should be determined largely by the cultivator himself, and will depend on the conditions under which the limes are growing. Providing the plants are growing under suitable soil conditions and have been given a fair chance in the early stage of growth, little or no cultivation is needed. The usual cutlassing four times per annum at the beginning—which may be reduced to twice per annum as the trees get older and the cover crops become established—should suffice for the growth of the plants on suitable land. This operation usually costs $3.00 per acre. If tillage is required, then a light forking occasionally at $7.00 per acre should be sufficient.

In some places, and more especially on the lateritic and sandy soils of the colony, it may become desirable to manure the trees with artificial fertilisers. Great caution is necessary with regard to this, as applications of active nitrogenous manures although apparently favouring the growth of the tree may for a time reduce its flowering and fruit-bearing functions. Our light soils are not unfrequently very deficient in potash and lime, and it is these constituents which may be the first to fail in lime cultivation. If from the appearance of the trees the desirability of artificial manuring is noticed, a mixture of sulphate of potash with either very finely ground slag phosphate or basic superphosphate should be tried. Probably an application of 2 cwt. of sulphate of potash intimately mixed with 1 cwt. of basic superphosphate and lightly forked into the soil near the margin of the cleared area around each tree will prove useful and remunerative. If applications of nitrogen are required, 80 lb. of nitrate of soda or 100 lb. of nitrate of lime per

acre should be scattered over the surface of the soil in a similar position to where the mixed manures are directed to be applied.

It has been for some time known that on heavy clay lands such as those near the coastland of the colony dressings of lime have a highly beneficial effect on the growth of limes and other citrus plants. Applications up to 11 lbs. of lime per tree may be made with advantage under these conditions. Fairly freshly slaked lime should be employed. On the lateritic soils, too, in the interior of the colony, lime would doubtless prove beneficial. To this type of soil lime which has been allowed to become thoroughly 'mild' would be preferable to freshly slaked lime.

PRUNING.

The pruning of lime trees requires some attention. There are some who hold that the trees can without danger be left to themselves; but there is little doubt that well-grown, shapely trees form a good asset to a cultivation. Long suckers and dead branches should always be removed, except when (in the case of the former) it is required to replace with them older branches which have died from some cause or other.

In this colony it has been constantly observed that lime trees tend in many cases to branch low down at an early stage. These low branches should be removed and a clear stem for a height of about 3 to 3½ feet preserved. The advantage in this is obvious, for it facilitates both weeding and the picking of the fruit.

Prunings should, where possible, be collected and burnt so as to avoid injury to the labourers from the spines. Coal tar should be placed on each cut surface in a thin layer after pruning.

(To be continued.)

Alcohol as Fuel in the Tropics.

Persistent agitation, during the past two years, in favour of alcohol as a source of power in the tropics, does not appear to have resulted so far in the achievement of anything definite. Several well-known authorities on sugar manufacture have advocated the utilization of molasses in this direction, and have shown that the proposition is a practical one ; other writers have called attention to the value of the by-products on banana, cacao and coconut estates ; while in sub-tropical countries the cultivation of corn and starch-producing crops has been mentioned as another source from which alcohol might be produced.

—"Agricultural News," Barbados, July 3, 1915,

Cotton Hybridisation at the Botanic Gardens.

By Prof. J. B. Harrison and C. K. Bancroft.

All of the numerous experiments made since 1902 with regard to the cultivation of Sea Island cotton demonstrated that, owing to the unsuitability of the heavy soil and of the meteorological conditions existent on the sea-board of the colony, the cultivation of the Sea Island cotton on or near the coastlands of the colony would meet with failure. The season 1907-8, the most favourable one during which the experiments were conducted, produced a yield only at the rate of 268 lbs. of seed cotton per acre. Other varieties have been under trial more or less continually since 1890, special trial having been given to certain Egyptian varieties. Sixteen varieties were under cultivation in 1904 and 1905. Some promising results were at first obtained by seed selection of Egyptian cottons. But it was evident as the result of the various trials that the different varieties would not yield lint in sufficient quantity to enable them to be grown at a profit. All of the varieties tried, except the Buck, were found to be very susceptible to the diseases prevalent among cotton plants, more especially to anthracnose and to cotton boll rot.

As the result of these trials, efforts were directed towards raising hybrids between the Sea Island and the native Buck cotton, the object being to combine the vigour and perennial habit of the latter with the quality of the lint of the former. The first successful cross fertilisation of Stirling Sea Island and the Buck was attained in January, 1906. The seeds obtained from the crosses, however, failed to germinate. Another set of crosses was made in 1907; and 105 of the F_1 hybrids were planted early in the following year. Field selection of the plants was made and those possessing desirable characters coupled with a good quality of lint were retained as parents of the 2nd generation. The selection was continued in the 3rd and 4th generations, and of the F_4 generation 24 plants were retained. Of these lint was selected from ten Nos. 1-10, and forwarded to the Imperial Institute for report and valuation in March of this year, along with two F_1 hybrids—Nos. 11 and 12 raised fromNative Suwardi and a hybrid Sea Island x Buck. The report received from the Imperial Institute indicates that the desired object has been attained. The report is as follows:—

"The hybrid cottons Nos. 1-12 are mostly of shorter staple and somewhat coarser than the sample of Sea Island cotton (No. 13). They are however stronger than the latter, and the brokers stated

that on account of their strength most of these cottons would be readily saleable at the prices quoted. It will be noticed that several samples, viz., Nos. 1, 5, 6, 8 and 11, were valued at higher prices than the Sea Island cotton No. 13, but that in no case was the value equal to that of "best Barbados" Sea Island cotton.

"The Native Buck cotton was of good quality and was valued at 0.68d. per lb. above "middling" American.

"It should be noted that the small size of the samples rendered it difficult to ensure exact valuations, and the present estimates of their commercial value must only be regarded as approximate.

"It is satisfactory to observe that the aim of obtaining a Buck x Sea Island hybrid yielding a cotton of long staple has been achieved, and it would be interesting to learn how the yields and hardiness of the hybrids compare with those of the indigenous Buck variety."

The Brokers' valuation of the lint from the different hybrid cottons varied from 11d. to 14d. per lb. with the best Barbados Sea Island at 14½d. The detailed reports of the different samples submitted, along with their valuations are as follows:—

IMPERIAL INSTITUTE.

Results of the Examination of Cotton from British Guiana.

I.

Date.	30th June, 1915.
Reference.	Letter No. 520 4820 dated 18th March, 1915, from the Director of Science and Agriculture Department, Georgetown.
Imperial Institute No.	58275-1.
Variety of Cotton.	Hybrid No. 1: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous of cream colour, and slightly stained.
Seeds.	Large black seeds, without fuzz.
Strength.	Fairly good.
Length of fibres.	From 1.5 to 1.9 inch ; mostly from 1.7 to 1.8 inch.
Diameter of fibres.	From 0.0005 to 0.00095 inch ; average 0.00069 inch.
Microscopical characters.	Normal.
Commercial valuation.	14d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

II.

Imperial Institute No.	58275-6.
Variety of Cotton.	Hybrid No. 6: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour and free from stains.
Seeds:	Black, medium-sized seeds with a small tuft of brown fuzz at each end.
Strength.	Good.
Length of fibres.	From 1.5 to 2.0 inches; mostly from 1.7 to 1.9 inch.
Diameter of fibres.	From 0.0005 to 0.00075 inch; average 0.00060 inch.
Microscopical characters	Normal. A small proportion of immature fibre was present.
Commercial valuation.	14d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

III.

Imperial Institute No.	58275-8.
Variety of Cotton.	Hybrid No. 8: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour and slightly stained.
Seeds:	Large black seeds, with a tuft of brownish fuzz at each end.
Strength.	Fair.
Length of fibres.	From 1.2 to 1.7 inch; mostly from 1.4 to 1.6 inch.
Diameter of fibres.	From 0.0005 to 0.0009 inch; average 0.00061 inch.
Microscopical characters.	Normal.
Commercial valuation.	14d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

IV.

Imperial Institute No.	58275-11.
Variety of Cotton.	Hybrid No. 11: Cross between Native Suwardi cotton and "Sea Island x Native Buck" hybrid.

Description.	Ginned and unginned cotton.
Lint:	Clean, fairly soft, lustrous cotton, of cream colour with a reddish tinge, and free from stain.
Seeds:	Large dark chocolate-coloured seeds, with a tuft of white fuzz at the blunt end.
Strength.	Good.
Length of fibres.	From 1.2 to 1.7 inch; mostly from 1.4 to 1.6 inch.
Diameter of fibres.	From 0.0005 to 0.00075 inch; average 0.00061 inch.
Microscopical characters.	Normal.
Commercial valuation.	14d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d to 17d. per lb.

V.

Imperial Institute No.	58275-5.
Variety of Cotton.	Hybrid No. 5: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour and free from stains.
Seeds:	Large dark chocolate-coloured seeds, with a small tuft of brownish fuzz at each end.
Strength.	Fairly good.
Length of fibres.	From 1.6 to 2.2 inches; mostly from 1.8 to 2.0 inches.
Diameter of fibres.	From 0.0004 to 0.00075 inch; average 0.00057 inch.
Microscopical characters.	Normal.
Commercial valuation.	13d. to 14d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

VI.

Imperial Institute No.	58275-4.
Variety of Cotton.	Hybrid No. 4: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour, and almost free from stains.

Seeds:	Large black seeds, with a small tuft of brownish-white fuzz at each end.
Strength.	Fairly good.
Length of fibres.	From 1.3 to 1.8 inch; mostly from 1.5 to 1.7 inch.
Diameter of fibres.	From 0.0005 to 0.0008 inch; average 0.00065 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. to 13d. per lb., with "best Barbados" at 14½d and "best St. Kitts" at 16d. to 17d. per lb.

VII.

Imperial Institute No.	58275 10.
Variety of Cotton.	Hybrid No. 10: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, fairly soft, lustrous, of deep cream colour and free from stains.
Seeds:	Large chocolate-coloured seed with a tuft of brownish or greenish fuzz at both ends.
Strength.	Fairly good.
Length of fibres.	From 1.4 to 1.9 inch; mostly from 1.6 to 1.8 inch.
Diameter of fibres.	From 0.0005 to 0.0009 inch; average 0.00063 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. to 13d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

VIII.

Imperial Institute No.	58275-3.
Variety of Cotton.	Hybrid No. 3: Stirling Sea Island x Native Buck.
Description.	Ginned cotton, clean, soft, lustrous, of cream colour and free from stains.
Strength.	Fairly good.
Length of fibres.	From 1.3 to 1.7 inch; mostly from 1.5 to 1.6 inch.
Diameter of fibres.	From 0.0005 to 0.0008 inch; average 0.00063 inch.
Microscopical characters.	Normal.

Commercial valuation. — 12d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

IX.

Imperial Institute No. — 58275-7.

Variety of Cotton. — Hybrid No. 7: Stirling Sea Island x Native Buck.

Description. — Ginned and unginned cotton.

Lint: — Clean, soft, lustrous, of cream colour and free from stains.

Seeds: — Black, medium-sized seeds, with a small tuft of brownish fuzz at the pointed end.

Strength. — On the whole, fair.

Length of fibres. — From 1.4 to 1.8 inch; mostly from 1.5 to 1.7 inch.

Diameter of fibres. — From 0.0005 to 0.00095 inch; average 0.00066 inch.

Microscopical characters. — Normal. A small proportion of immature fibre was present.

Commercial valuation. — 12d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

X.

Imperial Institute No. — 58275-9.

Variety of Cotton. — Hybrid No. 9: Stirling Sea Island x Native Buck.

Description. — Ginned and unginned cotton.

Lint: — Clean, soft, lustrous cotton, of cream colour and free from stains.

Seeds: — Large chocolate-coloured seeds, with a tuft of brownish or greenish fuzz at one or both ends.

Strength. — Fairly good.

Length of fibres. — From 1.4 to 1.8 inch; mostly from 1.5 to 1.7 inch.

Diameter of fibres. — From 0.0005 to 0.0010 inch; average 0.00066 inch.

Microscopical characters. — Normal.

Commercial valuation. — 12d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

XI.

Imperial Institute No.	58275-12.
Variety of Cotton.	Hybrid No. 12: Cross between Native Suwardi cotton and Sea Island x Native Buck hybrid.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour with a reddish tinge, and free from stains.
Seeds:	Large dark chocolate-coloured seeds, with a small black spike at the pointed end and a tuft of white fuzz at the blunt end.
Strength.	Fairly good.
Length of fibres.	From 1.4 to 1.8 inch; mostly from 1.4 to 1.6 inch.
Diameter of fibres.	From 0.0005 to 0.00085 inch; average 0.00063 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

XII.

Imperial Institute No.	58275-2.
Variety of Cotton.	Hybrid No. 2: Stirling Sea Island x Native Buck. average 0.00061 inch.
Description.	Ginned cotton, clean, soft, and lustrous, of cream colour and slightly stained.
Strength.	Fairly good.
Length of fibres.	From 1.3 to 1.8 inch; mostly from 1.5 to 1.7 inch.
Diameter of fibres.	From 0.0005 to 0.0008 inch; average 0.00064 inch.
Microscopical characters.	Normal.
Commercial valuation.	11d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

XIII.

Imperial Institute No.	58275-13.
Variety of Cotton.	No. 13: Sea Island.

Description.	Ginned cotton, clean, soft, lustrous, of cream colour and almost free from stains.
Strength.	Fair.
Length of fibres.	Irregular, varying from 1.4 to 2.1 inches ; mostly about 1.5 to 1.8 inch.
Diameter of fibres.	From 0.0004 to 0.00075 inch ; average 0.00056 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. to 13d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

XIV.

Imperial Institute No.	58275-14.
Variety of Cotton.	No. 14: Native Buck.
Description.	Ginned cotton, clean, harsh, fairly lustrous, of cream colour with a reddish-brown tint, and free from stains.
Strength.	Good.
Length of fibres	From 1.1 to 1.3 inch ; mostly from 1.1 to 1.2 inch.
Diameter of fibres.	From 0.0006 to 0.00105 inch ; average 0.00083 inch.
Microscopical characters.	Normal.
Commercial valuation.	6d. per lb. with "middling" American at 5.32d. per lb.

From the above it will be seen that three of the F_4 hybrids were valued at only ½d. per lb. less than the best Barbados Sea Island.

The work of propagating the hybrids is now receiving attention with a view to improving them by careful selection of seed.

Science After the War.

There is a tendency in the West Indies, like the one in Great Britain, for able young men to neglect science and agriculture as a profession, in preference to Law and Commerce. This war will mean a renaissance of science throughout the Empire ; and if the prospects before a scientific career have in the past been discouraging, there is a great possibility, if all goes well, that in the future the outlook will be a most attractive one.

—"Agricultural News," Barbados, September 11, 1915.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported this year up to June 30th. The corresponding figures for the three previous years are added for convenience of comparison.

Product	1912	1913	1914	1915
Sugar, tons	21,451	22,349	32,576	42,440
Rum, gallons	1,199,033	1,128,085	1,646,370	2,031,023
Molasses, casks ..	906	575	658	..
Cattle-food, tons ..	2,407	4,690	1,050	979
Cacao, cwts.	102	9	300	284
Citrate of Lime, cwts. ..	13	..	21	70
Coconuts, thousands ..	874	460	1,091	1,064
Copra, cwts.	913	620	820	842
Coffee, cwts.	1,050	647	1,756	678
Kola, Nuts, cwts. ..	..	..	..	2
Rice, tons	2,064	3,338	3,967	5,653
Ricemeal, tons	1,107	1,087	202	206
Cattle, head	314	338	623	307
Hides, No.	1,880	2,421	2,738	864
Pigs, No.	687	942	653	540
Sheep, head	39	18	12	4
Balata, cwts.	316	2,300	3,127	7,568
Charcoal, bags ..	37,825	28,691	36,861	28,236
Firewood, Wallaba, etc., tons	5,290	4,312	5,652	4,442
Gums, lbs.	2,425	1,515	719	..
Lumber, feet	99,550	292,233	198,145	31,619
Railway Sleepers, No. ..	3,876	1,503	2,602	556
Rubber, cwts.	1.3	.7	6	17
Shingles, thousands ..	819	1,269	1,061	1,070
Timber, cubic feet ..	163,261	222,929	132,468	85,807

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JOURNAL

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The Cause and Cure of "Witch-Broom" in Cacao.

"WITCH-BROOM" disease of *Theobroma Cacao* has been known in the neighbouring colony of Surinam for the last twenty years, and the damage it has caused has been so serious as to threaten the very existence of the cacao industry. In British Guiana it is not unknown, so that the real cause of the trouble has been the subject of a considerable amount of investigation. So far, while the authorities were all agreed that the disease was due to a fungus, much difference of opinion has existed as to the exact identification of the parasite concerned. Professor Ritzema Bos suggested that the fungus was an *Exoascus*—which he named *E. Theobromae*: Howard, in 1901, found *Fusarium* spores on the 'witch-brooms' and thought that these indicated that some Nectria was the cause of the trouble: Professor Went's experiments were inconclusive: V. K. Charles, in 1906, suspected a *Lasiodiplodia*: while Dr. van Hall and A. W. Drost in 1907, after a long and painstaking series of experiments declared that a fungus to which they gave the name of *Colletotrichum luxificum* was most probably the real cause of the disease.

A weak point in the proof, however, was the fact that inoculation experiments with *Colletotrichum* spores failed to reproduce the disease. J. B. Rorer, of Trinidad, in 1913, isolated a mycelium in pure culture from cacao plants affected with "witch-broom" which was not identical with that of *C. luxificum*, which did not form spores, but did regularly form 'clamp connections,' whence he concluded that the cause of the disease must be a Basidiomycete. But in this case also, inoculation experiments were unsuccessful.

The whole problem has now been carefully reinvestigated by Mr. Gerold Stahel, Government Botanist in Surinam, who has arrived at the conclusion that the witch-broom disease is caused by a basidiomycetous fungus, to which he has given the name *Marasmius perniciosus*. So far as he has been able to discover, this fungus has hitherto been undescribed. A complete account of the careful series of experiments which led him to his result will be found in the publications of the Department of Agriculture of Surinam—the particular paper* having the unusual virtue of appearing simultaneously in Dutch, English, and German. From a botanical point of view the paper records a very neat complete and exhaustive research, and one which appears to afford a final solution of the problem. From an agricultural point of view, the measures recommended by the author for the prevention and cure of the disease are worthy of the careful attention of the cultivators of cacao in British Guiana.

The witch-brooms, says the author, remain green for three to six weeks, and so long as they are green they are harmless. As soon as they begin to die off, however, they can form, even before they are quite dead, ***Marasmius*** fruit-bodies, provided the weather is suitable, *i.e.*, is damp enough—for it is during wet weather that the mushroom-like fructifications are produced in greatest abundance. During the rainy season, therefore, the trees ought to be exam-

* *Marasmius perniciosus*, nov. spec., der Erreger der Krulloten-Krankheit des Kakaos in Surinam ; von Gerold Stahel ; Dept. van den Landbouw, in Suriname,

ined and cleaned of witch-brooms every 2 or 3 weeks—in the dry season about every 4 weeks. The witch-brooms must be removed from the fields, or, if this is impossible, they must be rendered harmless on the spot by being burned or buried. They are a source of danger if left lying on the ground.

It is advisable to supplement this measure by spraying the trees with Bordeaux mixture. Spraying should be done at the end of the long dry season, say, in October or November, as the witch-brooms are then scarcest. The most careful searching at this time of the year is of great importance. Badly affected trees may also be sprayed during the short dry season, say, in February. When spraying, it is essential that the liquid should be extremely finely divided, so that it may penetrate the buds. The application of Bordeaux mixture has the additional advantage that the trunks and branches of the trees are kept free from moss and lichen, which prevent the development of flower cushions and make the detection of the cacao beetle very difficult. If the trees suffer from the attacks of leaf-eating insects, 0.05 to 0.1 per cent. of Paris green may be added to the Bordeaux mixture.

The treatment for a plantation suffering from a severe attack of witch-broom may, then, be summed up as follows:—

During the long dry season thin out the foliage, especially on the inside of the crown, and clean the trees of all witch-brooms and other diseased parts. Then spray thoroughly with a 2 per cent. Bordeaux mixture. During the entire rainy season remove the diseased parts once every two weeks and in the short dry season spray the trees again. Later it is necessary to spray only once annually, at the end of the long dry season, and to search the trees once every 2 or 3 weeks during the wet weather and once every 4 weeks during the dry season. Spraying may be discontinued when less than 3 to 4 witch-brooms are produced annually per tree. If the number of witch-brooms increases again to more than four annually, and these cannot be reduced by removal alone, spraying must be recommenced.

The Cultivation of Limes: II.

By Professor J. B Harrison, C.M.G., M.A., Director, and C. K. Bancroft, M.A. F.L.S., Assistant Director, Department of Science and Agriculture.

II.

INTERPLANTING.

THE minimum planting distance recommended for lime trees in the previous article on good flat land was 20 x 20 feet, while on steep slopes it was considered that the trees could be planted as close as 16 x 16 feet. The vigorous growth attained by the trees on good land in the colony does not, in our opinion, permit of their being planted closer to each other without undue interference resulting from the feeding area being too small for the roots of fully developed trees. If the trees are planted at the above distances it is obviously inadvisable to interplant any permanent crop among them; while on the other hand, the spacing of trees at greater distances apart, so as to allow of interplanting being done, must interfere with the economical working of the cultviation, since from the points of yield per acre and especially of low cost of labour in collecting the fruit, it is desirable to have large numbers of trees of the same kind per acre, *provided that they do not interfere with each other's full development.*

Interplanting of rubber with limes is very strongly condemned, inasmuch as (apart from the above considerations) the presence of an intercrop with rubber increases the cost of collecting latex from the latter to an extent which at the present range of prices for rubber is prohibitive.

Both Para rubber and lime trees are essentially surface-feeders, their roots forming an anastomosing network near the surface, while both are very susceptible to root diseases

COST OF ESTABLISHING A LIME CULTIVATION.

The establishment of a lime cultivation may be effected either from virgin or secondary forest or from an existing or abandoned cultivation. In the latter cases the actual amount of preparation of the land required will depend on the condition of the land previous to the commencement of operations for lime planting. It is not possible under these circumstances to give even an approximate estimate of the probable cost of preparing the land. We propose, therefore, to confine our estimate to the cost of establishing a lime cultivation from forest land in the colony.

The plantation should be laid out in 50-acre sections with narrow belts of forest trees left standing between the different sections The tops of hills should not be bared nor should very steep slopes be denuded of their forest growth. *It is essential from the point of view of high yields of limes per tree that the trees be protected from the prevailing winds.* Occasional gusts do not do much harm but exposure to persistent winds results in grave injury to the young growing shoots, giving rise to what is known as "stag-head."

Flat, low-lying river lands have to be empoldered and must be provided with drains which are capable of running off water fairly rapidly. The usual practice is to lay out these lands in long, relatively narrow, rectangles, or beds surrounding them by wide trenches for draining purposes and throwing the earth so derived to the outside of the trenches in order to make up the dams. Smaller cross drains, resulting in the production of approximately square or small rectangular areas, are led in to these larger channels and the water is thus run off at low tides of the river. When the estate has been laid out, and, if on flat land, empoldered, the forest is underbushed and felled and the timber stacked for burning. The drainage of the different sections is then attended to. After this is completed the land is lined, holed and planted. The subsequent operations are supplying, weeding, mulching, pruning, and the treatment of diseases and pests.

THE ESTIMATE PER ACRE.

The following is an estimate of bringing to the bearing stage (6th year) an acre of limes in a cultivation of 100 acres:—

	$ c.
Fees, Application, Survey, etc.	51
Underbushing, Felling, etc.	12.00
Burning, Clearing, Restacking and Burning	15.00
Lining and Holeing	5.00
Planting	2.00
Cost of Plants	1.20
Weeding (1st year)	12.00
,, (2nd year)	9.00
,, (3rd year)	6.00
,, (4th year)	6.00
,, (5th year)	6.00
,, (6th year)	6.00
*Superintendence	60.00
Buildings	15.00
Other Operations and Contingencies, say ..	9.29
TOTAL	165.00

The above estimate provides for thorough burning and clearing of the forest and for fairly clean weeding. It does not include roads, which are necessary on an estate in the interior of the colony, or drainage. The cost of cart roads may be estimated at $20 per acre and of drainage on an estate in the interior, another $10. On the low-lying land on the river banks no roads are required as the trenches serve this purpose; the drainage of these lands is, however, more costly and may be estimated at $15 per acre for establishment and $3.00 per acre per annum for maintenance, making a total of $30.

The cost of bringing an acre of limes to the bearing stage in a cultivation of 100 acres may, therefore, be taken roughly as $195 or £40 12s. 6d.

FACTORY, MACHINERY, ETC.

The machinery required depends to a great extent on whether concentrated lime juice or citrate of lime is to be manufactured. In the former, the cost of the machinery will be less than in the latter case. The following is

*This item is calculated on the assumption that the whole of the expenses of supervision falls on the area established under limes. The larger this area is the lower the cost per acre for supervision.

an esitmate for a citrate factory capable of dealing with 8,000 to 10,000 barrels of fruit per annum:

Lime mill, 3 rolls, (steel), 20 x 14 inches ..	$ 370.00
Oil Engine, 5 H.P.	316.00
Boiler, one 6 H P. Vertical, with Feed Pump	650.00
Foundations. Concrete blocks, 3 ft. thick, with width to suit Mill, Engine and Boiler, respectively	108.00
Engineers and Porters erecting Mill and Engine	300.00
Vat Still, 6ft. diam by 5ft. high, capable of distilling 150 gals of lime juice per hour	60.00
Vat for cooling worm, say 4ft. x 3ft high .	30.00
Goose Neck 12 ins to 3 ins. or 9 ins. to 3 ins. and Pewter Worm, 30 ft, 3 ins. to ¾ inch outlet	200.00
Filter for hot juice from Still	50 00
Small Steam Pump with brass barrel and plunger, capacity, 200 gals. per hour. with 20ft. copper piping, 1½ inches diameter	50.00
Small Centrifugal (24 ins Basket) with Engine. Capacity 100 lbs Citrate per hour	600 00
5,000 gals. Vat for rain water supply ..	150 00
Small Pump for water supply; capacity, 500 gals. per hour	120 00
Neutralising Box, capacity, 100 gals., made of 2in planks, outside measurements, 8 x 4 ft. x 3ft deep	25.00
Two washing Boxes of same size as above ..	50.00
Drying Oven, 80 square feet, protected from weather by light roof and sides ..	360.00
Factory Building, including airing room, laboratory, lime fruit store and finished citrate store	960.00
Laboratory fittings	50.00
Steam and Water Piping, Valves, etc. ..	300.00
Juice Receivers, Gutters, Strainers, etc. ..	100.00
Transportation	275.00
Contingencies, 10 per cent.	512.00
TOTAL	$5,636.00

For making concentrated lime juice the following is an estimate for a plant capable of dealing with 8,000 to 10,000 barrels of limes per annum:—

Lime Mill, 3 Rolls (steel), 20 x 14 inches ..	$ 370.00
Oil Engine, 5 H.P.	316.00
Boiler, one 6 H.P. Vertical, with Feed Pump	650.00
Foundations, Concrete Blocks, 3 ft. thick with width to suit Mill, Engine and Boiler, respectively	108.00
Engineers and Porters erecting Mill and Engine	300.00
Vat Still. 6ft diam. x 5 ft. high, capable of distilling a charge of 150 gals. per hour	60.00
Vat for cooling worm. say 4ft. x 3ft. high	30.00
Goose Neck, 12 ins to 3 ins. or 9 ins. to 3 ins. and Pewter Worm, 30 ft., 3 ins. to ¾ inch outlet	200.00
Small Steam Pump with brass barrel and plunger; capacity, 200 gals. per hour with 20ft copper piping, 1½ ins. diameter	50.00
Vat or coolie tank for water supply ..	30.00
Small Pump for water supply; capacity, 500 gals. per hour	120.00
Juice heaters, two, wooden	50.00
Storage Vat 500 gals.	50.00
Subsiding Vats, five, size, 2ft. 6ins. x 2ft. 6ins x 5ft high	50.00
Factory Building	750.00
Steam and Water Piping, Valves, &c. ..	300.00
Juice receivers, Gutters, Strainers, &c. ..	100.00
Transportation	275.00
Contingencies, 10 per cent.	380.00
TOTAL	$4,189.00

A proprietor possessing an area of say 20 acres would require at the commencement, the following equipment:—

Hand or cattle mill	$180.00
1 Copper tayche, 50 gals.	150.00
1 do. 80 gals.	180.00
2 Vats 2′ 6″ x 2′ 6″ x 5′	20.00
TOTAL	$530.00

Should the proprietor be desirous of making distilled oil of limes, then he will require a still of capacity 50 or 60 gals.

Later another tayche will be required of 100 gals. capacity. A storage vat, and a copper still will also be required.

The type of mill given in the above is a 3-roll horizontal mill, 18″ x 10″, as supplied by Messrs. Geo. L. Squire M.F.G. Co, Buffalo, N.Y., U.S.A.

A cheap hand or cattle mill can be made of a greenheart frame with rolls of turned greenheart.

A complete factory for a large acreage should be capable of preparing lime juice of high quality from selected fruit, concentrated juice and citrate of lime according to the relative market value of these products. Granite rolls or a subsidiary mill with granite rolls will be required for making the first-mentioned product.

If the factory is run as a subsidiary to a sugar factory the requirements will naturally be less and it will be found that several of the above items may be dispensed with and the cost of equipment therefore appreciably lessened.

LAND TENURE AND VALUE.

The following are the principal terms and conditions on which land may be leased from the Crown for cultivation in limes:—

No rent is payable during the first five years of the lease, but the lessee pays an annual rent of twenty-five cents an acre from the sixth to the tenth year inclusive, and an annual rent of eighty cents an acre during the remainder of the lease and in default of payment of such rent on the day on which the same is due, the lessee, in

addition, pays interest thereon at the rate of six per centum per annum for each day of such default.

The lessee shall each year plant not less than one-twenty fifth part of the land leased until he has so planted not less than seven twenty-fifth parts of the said land, and shall maintain such cultivation in good order to the satisfaction of the Governor-in-Council or of such officer as may be from time to time deputed by the Governor-in-Council to inspect the cultivation.

The fees payable for obtaining a lease, which must be deposited with the application, are as follow:—

Application	$5.00
Survey :—	
Areas up to 500 acres, per acre	30
Each acre above 500 and up to 1,000	20
Each acre above 1,000	10

These charges include labour, cutting lines, etc.

The lessee is also required to pay the cost of drawing up, executing and stamping the lease in Registrar's Office, say $16.20.

(*To be Continued.*)

Botany and the Text-Book.

We do not think that Botany can be taught with advantage to children from books. No method of teaching seems so well adapted to the wants of junior students as that of demonstration. A flower pulled to pieces by the student and the parts and their importance intelligently explained by the teacher forms a lesson far more valuable than any to be got from a text-book. With a few such demonstrations from easily-obtained flowers, taken as they present themselves, most of the elementary facts regarding flowering plants can be readily mastered, while the habits of observation and the facility of dissecting thus obtained are invaluable to the student. It is, we fear, too much the habit in teaching botany to make the student prepare a lesson from the text-book as if it were spelling or history. This is really what should be most carefully avoided, although there must be a great temptation to proceed with the book lesson when the plant is not obtainable.

— "Nature," Vol. XXIII., January 13, 1881.

Agricultural Instruction in Surinam

By Mr. J. J. Leys, Government Agricultural Lecturer, Surinam.

AGRICULTURAL instruction in Surinam is totally separated from primary education, and is put under the supervision of the Director of Agriculture. The aim of the instruction is to give to young agriculturists a theoretical knowledge of agriculture.

Lessons are given in agricultural chemistry, botany, zoology, physics, cattle rearing, and dairy work, the tilling of the soil and the use of agricultural tools, and the principles of manuring Particular directions are given for cultivating agricultural and garden plants and fruit.

A course for young farmers lasts two years, of 40 school weeks each and 12 holiday weeks. Every week a lecture is given lasting three hours. The first year of the course is used to give the pupils some theoretical knowledge, in order that they get an insight into some of the problems of nature, such as the life of plants and animals, the movement of water in the soil, and the atmosphere, and to make them acquainted with words and expressions which they will meet in after years when they read books and papers on agricultural subjects. This is the object of the lessons in chemistry, botany, zoology and physics.

The second year is devoted to practical knowledge—the tilling of the soil, tools, drainage, manuring, cattle-rearing, dairy work and the cultivation of agricultural plants. Those plants which are cultivated on the farms of the neighbourhood are treated more fully. For instance, the cultivation of cacao, coffee, cassava, rice, Taya, sweet potatoes and oranges is treated quite fully in my course at Domburg because my pupils there spend their lives in cultivating those plants, whereas the students at my course given at "Second Road" (one hour west of Paramaribo) do not grow cacao or coffee or rice, so I do not treat those plants so fully—the culture of bananas and water melons comes in instead. Cattle-rearing is also fully gone

into in the Second Road course as the place is situated in a stock-raising district. So the local circumstances fix what branch of Agriculture will be treated the more fully.

THE AGE-LIMITS FOR PUPILS.

The minimum age at which the pupils are admitted is 15 years. At that age they have already some practical experience. A maximum age is not fixed, so that we have pupils of forty and forty-five years of age, farmers who are at the head of a business or managers of plantations. Now and then excursions are made to a plantation or farm.

The lectures on cattle-rearing are at present confined to the cow and the pig: in after years it may be possible to treat of horse and donkey-rearing and poultry-raising. The different breeds of cows are considered, the improvement of the strains, crossing, feeding and cattle food, the treatment of milk and the making of butter.

THE TREATMENT OF SCHOOL TEACHERS.

School teachers who wish to take such a course must have a certificate in agriculture. Every two years a special examination will, in the future, be held to enable them to obtain this certificate. The examination will last two days, the subjects being the same as those treated in the course for young farmers. Of course, the teachers cannot study by themselves, they must have guidance, and to give them this a regular course of two years is provided, forty weeks being utilized in each year. The lectures— which include experiments—are given on Saturdays from 9 a.m. till 1 p.m., with half an hour for rest, from 11.30 to 12.

The First Year (Primary) Lectures are given from 9—10.30 in Chemistry by Mr. Leys; from 10.30—11.30 in Physics by Mr. Leys; and from 12—1 in Agricultural Botany by Agricultural Assistant Drost.

The Second Year (Secondary) Lectures are given in the Tilling of Soil, Origin of the Soil, and Manuring by Mr. Huizinga, Director of Agriculture; in Botany and Zoology by Mr. Leys; and in Agricultural Botany by Mr. Drost. We try to unite theory and practice by visiting farms and plantations: in course of time we shall try to establish Model Gardens.

WORK IN THE COUNTRY DISTRICTS ENCOURAGED.

If a school teacher, after having followed a course of two years, passes his examination, he gets a certificate with $40 as a premium wherewith to pay his expenses in buying books. The only thing he has to do now is to try and gather a number of boys (minimum 15) of 15 years of age and upwards, in his native town or in the neighbourhood. If he succeeds in getting that number he is appointed 'headmaster' of a course described under the name of "Course for Farmers' Boys." His salary as an agricultural teacher is $220 if he lives in a country district—in Paramaribo it is $140. The extra $80 is given as an inducement for the teachers to go and work in the country districts.

The time has not yet arrived to speak of any success. We started our primary courses in March, 1915, and our secondary course in May of the same year. Not before 1917 shall we be able to speak of results. In that year, when our first secondary course is completed, we shall be able to start primary courses under certificated Surinam teachers.

THE PROSPECTS FOR THE FUTURE.

In order to help these teachers with their difficult work we needs must have some experience; that is why I have started two primary courses conducted by myself. One course is given at Domburg, six miles up the Surinam river, and the other at Second Road, four miles west of Paramaribo. The first is attended by 40 pupils, the second by sixty. These courses have been running now for seven months, and the pupils are following the lectures with great interest. Some of the boys have to walk six miles to attend the lessons. If the students show the same interest when the primary courses are conducted by Surinam teachers, then our success is assured.

Generally speaking, the agricultural courses in Holland are given according to the same method, and there we may speak of a big success. Every agricultural teacher, when he starts a course, is strongly advised to establish a school garden—not to make agriculturists of his boys, (for if he thinks that, he will always experience that school gardens are a failure) but to impart to his pupils a love of Nature and ground them in the first principles of agri-

culture and the use of tools. In Europe, at least, every boy, when grown up, will have a large or a small garden in which he will work for recreation or for economic purposes. The value of a school garden is even greater to the agricultural teacher than to his pupils: by its means he remains in contact with practical agriculture, he is able to communicate his experiences to the pupils of his agricultural courses, and he finds demonstration material for his lessons.

Sunflower Growing for Seed.

The sunflower will grow in almost any soil and in any climate. It will bear cold or heat, drought or rain. It is subject to no disease, and to no climatic disqualification. The cultivation is very simple. The plant is not at all particular, but prefers light, rich, well-drained soil. It is advisable to sow early—say, the beginning of September—to secure perfect maturity. The quantity of seed required per acre will vary from 4 to 6 lb. It should be sown in drills 5 ft. between the rows, and the seed drilled wards be thinned out, if found necessary owing to exuberant growth, to ensure full exposure to the sun—a very necessary condition. As the plants have a habit of spreading their branches and heads in successive layers over each other, thinning is generally necessary. When 12 in. high a slight earthing up benefits the plants. Sunflowers with many heads do not ripen the seed evenly, therefore it is better to cultivate a species producing only one large head to each plant.

The "Tall Mammoth Russian" is such a variety, and may be planted closer. It produces more seed than any other sort, and can be obtained from most seedsmen. It has often produced flower heads 15 in. in diameter and bearing over 2,000 seeds.

The leaves of the sunflower, when sun-dried and pounded, and mixed with meal or bran, make good fodder for milch cows. The oil expressed is almost equal to olive oil

We are not sure of the wholesale price now ruling for the seed; before the war it was quoted at £12 per ton.

—"Queensland Agricultural Journal," April, 1915.

The Birds of British Guiana.

By Charles B. Dawson, S.J., M.A., (Oxon.)

I.

I purpose in this and in following articles to give a brief, general description of all the Classes, Orders, Families, and Genera of the birds of the Colony with some account also of their habits, characteristics, and affinities. I shall treat separately such species as are typical, abnormal, or in any way worthy of special mention. The reader is supposed to be familiar with the specimens in the local Museum and to have some knowledge at least of Ornithology.

There are in the world upwards of seventeen thousand species of birds known to science, of which this Colony can boast some seven or eight hundred.

I append a complete list of the Colony birds which I have compiled from the Hand-List of the British Museum. I may remark in passing that there are many more species of birds found in this Colony than are notified as such in that Hand-List, (1899-1912).

A few years ago, *The Argosy* published a list of Colony birds drawn up by Mr. Rodway from the specimens collected by Mr. Quelch, B.Sc., the former Curator of the Museum, but it is now out of print and, moreover, needs revision. Previously, in the year 1884, Osbert Salvin, M A, F R S., published a list of British Guiana Birds in the "Ibis" based upon a series of collections made by Henry Whiteley during the years 1879-84; but this also is not now procurable and would need revision

To the former of these lists I am indebted for the English names of many birds. Where no English name appears to exist I have ventured to supply that defect by one suggested either in the Latin title or by some peculiarity of the bird itself; this I have indicated by a dagger, thus: †. I refrain from naming a bird from its discoverer. as for instance, "Whiteley's Toucan," because such names are no real indication of the bird itself; I prefer

to call this particular bird, "the Sea-green Toucan," since sea-green is its prevailing colour. And so of others. Calling a bird after the name of a place is open to the same objection.

Where the specimens in the Musum do not represent, at least at present. the whole Class or Order, I have indicated absent forms by an asterisk; and where species are doubtful, as birds of this colony, or are only chance visitors, I have marked them thus, (?).

Some apology may be thought necessary for the order I have adopted in presenting the different Classes and Orders Birds have affinities, whether of habits or structure, in so many directions, and the conclusions of Science are at present so conflicting and indeterminate, that I have felt myself free to follow an arrangement of my own. Thus I have placed Eagles and Hawks at the head of the list because they are the most masterful of all the feathered tribes· not because I am unaware that, in the order of evoluton,* *Ratitae* (of existing birds) are generally placed in that position. So also I have placed Sugar-birds and Humming-birds in juxta-position because, whatever and however divergent, their process of evolution may have been, they have strong outward affinities and resemblances. Similarly also swifts and swallows, king-fishers and jaçamars. Where no such strong outward affinities are present I have been content to follow the provisional conclusions of Science. and thus I have placed cuckoos near parrots, and wood-peckers near toucans. Further, I have placed tyrant-birds near barbets and the two Orders of barbets together for the sake of mutual comparison and contrast. So of other forms. In all cases their scientific status is clearly denoted. At present the whole arrangement of birds in Classes and Families is, to say the least, more or less tentative. It is doubtful whether a final and satisfactory settlement will ever be arrived at.

Birds of Prey.

Under this popular title may be included all raptorial birds such as Eagles, Vultures, Hawks, Harriers, Buzzards, Kites, Falcons; as well as Owls and Night-jars.

* There are not wanting Ornithologists who would describe Penguins (*Spheniscidae*) as the most ancient form of bird.

It has been convenient also to include the solitary Colonial specimen of the corvine family, the Jay. The Colony has more than its due proportion of raptorial birds, there being some fifty species of hawks and vultures, twelve of owls and the same number of night-jars or goat-suckers.

Vultures number twelve genera and twenty-six species. Hawks, including all the rest, some eighty genera and four hundred and eighty species.

Hawks and *Eagles* may at once be recognised by their upright and dignified carriage, their piercing and intelligent eyes, hooked beaks and powerful claws or talons. The females are generally larger than the males, but not so brightly coloured; in some species, notably among the harriers, the females differ so entirely from the males that they have often been mistaken as birds of different species.

Vultures are the scavengers of the earth and may be known by their bare heads, and less powerful feet. They feed on carcases which they easily descry, as they soar aloft, by their telescopic vision. Their sense of smell, as is the case of birds generally, is weak. They do not disdain to feed on flesh and offal in a high state of putrefaction, plunging their heads into the reeking mass.

The *Harpy Eagle* is the most powerful of his masterful tribe and is so named after the fabled monster of classic lore. He ranges throughout tropical America and preys upon such mammals as sloths, fawns, pecaries, and monkeys. He must not be confounded with the *Crowned Buzzard*, a bird of different calibre. Buzzards are slow and heavy of flight and some of them content themselves with such fry as small lizards, amphibians and even beetles. One of them, the Awl-billed Buzzard or Kite (as it is called) has a slender, hook-like, maxilla (or upper beak) designed for extracting snails from their shells. In case of need, buzzards and some other hawks will even feed upon leaves and berries.

The *Osprey* or Fishing Hawk, is an eagle in size and power and feeds entirely on fish which it procures by diving, sometimes from a great height, into their watery element. Its outer toe or talon is reversible, and thus it is able to hold its slippery and struggling prey securely.

Its range is world-wide and it has been known to breed in Great Britain It was formerly classed among falcons, but is now regarded as belonging to a separate family.

Falcons are bold, long-winged, swift-flying hawks; and chase their prey with vigour, seizing it as it flees, with great skill. They are, distinguished by having a notched maxilla. To this class belong Kestrels, Hobbies, and the beautiful Merlin.

Kites may generally be known by their forked tails. One of the most remarkable is the Swallow-tailed Kite, which, as it soars on high after the manner of its tribe, might easily be mistaken for a large swallow. Kites are closely related to Buzzards.

Under the term Hawk are included all diurnal raptorial birds that are not Eagles or Vultures, Buzzards or Kites, Falcons or Harriers. The word is used in a general sense of all these birds.

Harriers were originally so named from their habit of harrying poultry They are distinguished by having a frill something like that of an Owl. In flight they resemble Buzzards, but walk more quickly on the ground. They affect the open country and prey upon snakes and frogs.

The *Caracara* or Carrion Hawk is a connecting link between hawks and vultures, having the structure of the former with the habits of the latter. It runs easily and quickly upon the ground, a thing uncommon among hawks, and is often seen in company with the Black Vulture. There are several other kinds of hawks which have similar characteristics; but not in such a marked degree. Caracaras, when other food fails, will eat insects, worms and seeds.

The *Black Vulture,* erroneously called the Carrion Crow or Turkey Buzzard, of which there are four species in the Colony, is a common object. He may be seen at all times either soaring high in the air, or scrummaging around a dead dog or fowl thrown out on the roadside. At a distance these vultures might easily be mistaken by the uninitiated for small turkeys, hence their alternate popular name. On the ground they move with a hop and a stride.

The *King Vulture* is so designated from the gaudy colours and coruncle that adorn his bald head, giving him the appearance of being crowned; not from any courageous or kingly qualities

Eagles and large Vultures build their nests amid rocky fastnesses; falcons often choose rocky ledges on crags in retired places: hawks build nests of sticks in trees, or even utilize the abandoned nests of other birds. The smaller vultures build their nests on the ground or on low shrubs in retired places. On this account, the Black Vulture has been almost exterminated in Jamaica by the Mongoose, unfortunately introduced into that country, for these animals love eggs

Hawks' eggs are generally beautiful objects (Ospreys' particularly so), being streaked and blotched with rich red, brown, or purple. The cry of hawks and eagles is a peevish sneer or snarl; that of vultures generally a grunt.

Hawks are recognised as enemies by all the feathered tribes and mobbed without mercy whenever they appear. It is a common sight in Georgetown to see the Chima-Chima Hawk pursued by Kiskadees or even Swallows.

HAWKS AND VULTURES—(Colonial.) *Cathartidiformes—Accipitriformes.*

Eagle-like forms (*Aquilinae.*)—	
Osprey or Fishing Eagle	*Pandion haliaëtus.*
Harpy Eagle	*Thraëtus harpyia.*
Crowned Eagle (or Buzzard)	*Morphnus guianensis.*
White-breasted, or Crowned Hawk-eagle	*Spizaëtus ornatus.*
*Black-breasted, or Crowned Hawk-eagle	,, *tyrannus.*
Black Hawk-eagle	*Spiziaster melanoleucus.*
Cathartidiformes—	
King Vulture	*Gyparchus papa.*
Black-headed Vulture (Carrion Crow, etc.)	*Catharista atratus* (*urubu*)

Yellow-headed Vulture	*Rhinogryphus (Cathartes) perniger.*
Turkey Vulture	*Rhinogryphus (Cathartes) aura.*
Yellow-and-red-headed Vulture	*Rhinogryphus burrovianus.*
Buteoninae—	
Common Buzzard	*Tachytriorchis albicaudatus.*
Lesser ,,	*Tachytriorchis abbreviatus.*
Short-tailed ,, (White-fronted)	*Buteola brachyura.*
Grey-barred Sparrow Buzzard (or Hawk)	*Asturnia nitida.*
Common Chicken Buzzard (great-billed)	*Rupornis Magnirostris.*
White-banded Red Buzzard	*Heterospizias Meridionalis.*
Black-necked Crab Buzzard	*Busarellus negricollis.*
Black-headed ,, ,,	*Buteogallus aequinnoctialis.*
White-necked ,,	*Leucopternis albicollis.*
Streaked ,,	,, *melanops.*
Black Chicken ,,	*Urubitinga urubitinga.*
Wattled Chicken ,,	,, *anthracina.*
Snail-eating Buzzard or Kite	*Rostrhamus sociabilis.*
Grey Snail-eating Buzzard or Kite	,, *leucopygus.*
Kites—	
Swallow-tailed Kite	*Elanoides furcatus.*
Cayenne ,,	*Rogerhinus ,(Leptodon.) cayennentis.*
Hooked-billed ,,	,, *uncinatus.*
Yellow-faced ,,	*Gampsonyx swainsoni.*
Pigeon-Hawk ,,	*Ictinia plumbea.*
Grey or Pale ,,	*Elanus leucurus.*
Polyborinae. Carrion hawks—	
†The Brown Caracara	*Polyborus cheriway.*
†*White-necked ,,	,, *tharus.*

Black Caracara or Tick Hawl.	*Ibycter ater.*
White-billed or Bush Carrion Hawk	„ *americanus.*
White-headed or Chima-Chima Hawk	*Milvago chima-chima.*

Accipitrinae—

White breasted Harrier-eagle	*Herpetotheres cachinans*
State coloured Harrier-eagle	*Geranospizias caerulescens.*
*Blue Harrier-eagle	„ *gracilis.*
Spotted Harrier	*Circus maculosus.*
Black Harrier	*Micrastur melanoleucus.*
White-breasted Harrier	„ *mirandollei.*
Red-necked „	„ *ruficollis.*
Yellow-necked „	„ *gilvicollis.*
†Breast-plated Goshawk	*Astur pectoralis.*
Small Sparrow-hawk	*Accipiter subniger (tinus.)*
*Red-legged Sparrow-hawk	„ *bicolor.*
†Capped .. „	„ *pileatus.*

Falconinae—

Large Merlin (or Baridi)	*Falco fusco-coerulescens.*
Small Merlin (or Baridi) (White-throated)	„ *albigularis.*
Orange-breasted Hobby	„ *aurantius.*
Cuckoo Falcon (Double-toothed)	*Harpagus bidentatus.*
†Path Falcon	„ *diodon.*
Small Kestrel	*Tinnunculus (Cerchnis) isabellina.*
American Sparrow hawk	*Tinnunculus (Cerchnis) sparraria*

Owls.—Like Hawks, these birds have powerful talons, hooked beaks and an erect carriage. The beak, however, is not so powerful, for whereas Hawks tear their prey to pieces before devouring it, owls generally swallow it whole, and afterwards reject the bones with fur or feathers, in the form of pellets. They may be recognised at once

by their cat-like visage and forward stare. The face is surrounded by a frill, generally of white feathers; the feathers of the head are loose and fluffy, and in consequence it looks much larger than it really is. As they are, with few exceptions, nocturnal in their habits, Nature has provided them with specialized eyes, highly developed ears to catch the slightest sound, and soft feathers to ensure a noiseless flight. Some are adorned with tufts of feathers on the head that look like horns or ears; but these are of no importance in determining Orders or species. There is a general uniformity in the plumage of owls: none are highly coloured; browns, dull yellows and buffs, with white, and occasionally black markings are the prevailing tints. The iris of their abnormally large eyes is bright amber which gives them a malignant look.

Owls are divided into two distinct families, differing from each other in the structure of the *sternum* or breast-bone: *Striginae,* including the Screech Owl, and *Bubonidae,* including the Tawny Owl of England; nearly all the species in this Colony belong to the latter family, which is further distinguished by having a reversible outer toe, like that of the Osprey. This, at will, it can turn right back as it generally does in perching. The Screech Owl is cosmopolitan, being found in almost all countries of the world. It is the Barn-Owl of England. The cry of owls is strange and weird; sometimes a screech, sometimes a wail as of someone in pain, and at other times a bark or "woof." They build their nests in holes of trees, or make no nests at all, simply laying their eggs on the decayed wood. The eggs are glossy white and spheroid in shape; the young are covered with down.

Hawk-Owls are diurnal and have lost to some degree their owl-like peculiarities, the facial disc, and prominent eyes; and their fluffy feathers. The Hawk-Owl of the Colony, *Ciccaba huhula,* is noticeable as having hawk-like plumage.

Burrowing Owls, found in both North and South America, are also mainly diurnal in habits. They live in warrens, either made by themselves or, as it were, rented from other animals with whom they live in perfect agreement. In North America they may be seen living in harmony with prairie-dogs, rats, squirrels, or badgers; in

this colony, with armadillos, large lizards, and even rattle-snakes. They seem to have established a mutual truce. They feed on small mammals, birds, reptiles, and insects. They have almost lost their frill or ruff.

There are twenty genera and more than three hundred species.

The Oil Bird.—Intermediate between Owls and Night-jars, is placed the Guacharo or Oil-Bird, now said to breed in this colony. About the size of a crow and with a similar beak, it has stiff bristles in each side of the gape, its plumage being chocolate and grey, barred with dark brown or black and spotted with white. The legs are feeble, but the wings are large. It inhabits dark caverns, congregating in large numbers, and only issuing forth at night to feed on oil-nuts and fruit. It builds its nest of clay wherein are deposited about four white eggs, often very dirty. The young are so fat that the Indians take them for the purpose of extracting their oil, which they use for lamps, etc. In this way, thousands are slaughtered. In some places the young are esteemed as a delicacy, though their odour is said to be that of cockroaches. Only one species of this bird is known. Their cry is a loud, croaking, rasping utterance.

Night Jars or Goat-suckers are partly owl-like in structure and partly like swifts, having affinities to both. Needless to say, their second name is founded in a fiction. Like Owls, they are chiefly nocturnal in their habits. They make strange noises; sometimes with a harsh, metallic ring, hence their name. Strangers to the bush are sometimes surprised at dusk by hearing voices, calling from all sides in mournful tones, "Who are you?" This is the *Nyctidromus albicollis*, which is very common in open places.

Night-Jars frequent the open, laying eggs on the bare ground. There they crouch during the day and will almost allow themselves to be trodden upon before moving off They do not perch upon trees, but will lie along the branches. Their plumage is soft, and moth-like in colour. Their eggs are mottled with purple. They feed on moths and beetles which they pursue with open mouths; their gape is enormous and is generally beset with strong bristles.

Certain species of the genus *Chordiles* are semi-diurnal and may sometimes be seen chasing their prey with vigour in broad daylight. There are twenty-three genera and one hundred and forty-nine species.

The *Jay* is our solitary example of its kind and has no affinities in this colony. Its habits are not known. The European Jay feeds on berries, fruit, young birds, and eggs, and in England has almost been exterminated on account of the depredations it makes in orchards and pheasant runs. It builds its nest of twigs and roots and therein lays from four to seven eggs of a light green colour closely freckled with olive. Our Colony Jay has probably similar habits. Of the Crow tribe, there are some forty genera and some two hundred and eighty species, of which about sixty species belong to the New World.

OWLS (Colonial). *Strigiformes.*

Owls—

Large eared Owl	*Bubo virginianus.*
Small ,, ,,	*Asio Clamator.*
*Sharp-sighted Owl	*Pulsatrix perspicillata.*
Collared ,,	,, *torquata.*
Scops ,,	*Scops brasiliana.*
,, Roraima Owl	,, *roraimae.*
*Tufted Scops ,,	,, *atricapilla.*
Guatemalan Scops Owl	,, *guatemalae.*
Scops Small-eared Owl	,, *asio.*
*Hawk-Owl	*Ciccaba virgata.*
Brown ,,	,, *hulula.*
Moth Owlet	*Glucidium phalaenoides.*
Burrowing Owl	*Speotyto cunicularia.*
Screech Owl (Barn Owl)	*Strix flammea.*
Steatornithidae	,, *perlata.*
The Oil-bird (?)	*Steatornis caripensis.*

Night-jars (*Caprimulgidae.*)—

The Great Night-jar (or goatsucker)	*Nyctibius grandis.*
Jamaican Night-jar (or goatsucker)	,, *jamaicanensis.*
Long-tailed Night-jar	,, *longicandatus.*
Sharp-winged ,,	*Chordiles acutipennis.*
*Grey-rumped ,,	*Nyctiprogue leucopyga.*

Fleecy „	*Podager nacunda.*
Schomburgh's „ (water-scissors)	*Hydropsalis Schomburghi.*
White-Collared Night-jar	*Lurocalis semitorquatus.*
Who-are-you? Night-jar (Night-flyer)	*Nyctidromus albicollis.*
Guiana Night-jar (narrow-faced)	*Stenopsis cayennensis.*
†Red-necked Night jar	„ *ruficervix.*
Small Black Night-Jar	*Caprimulgus nigrescens.*
„ Red „	„ *rufus.*

Crows (*Corvidae.*)—

The Guiana Jay	*Cyanocoras Cayanus.*
*Purple „ (?)	„ *violaceus.*

Tyrant Birds.

These birds belong to the great Order of *Passeriformes* and are thus distantly related to the Colony Jay. They are only found in the New World. The name appears to have been first given to the King-bird of North America on account of its boldness in attacking hawks and even eagles and driving them off. It is hardly applicable to many of the colony species, though our Kiskadee certainly merits the title. In habits, some of these birds resemble the European shrikes or butcher-birds; others, the fly-catchers; and one at least, (the Cotton Bird) the wagtail. The family comprises many different forms, but all are insectivorous, some varying their diet with fruit, and the larger forms with eggs, young birds, and small lizards. None are gaudily coloured; brown, red, grey, dull-yellow, with markings of black or white are the prevailing tints, relieved in the Kiskadee and others with bright yellow, and in the *Pyrocephalus rubineus* with bright scarlet. The scissor-tailed Tyrant-Bird is remarkable for its long, forked, tail, and the Royal Tyrant-Bird for its half-moon crown-like, crest. The note of these birds is generally loud and harsh; there are no songsters among them.

The Kiskadee (sometimes written *Qu'est-ce-qu'il-dit* from a fancied resemblance of its loud note to these words) is, in this colony, facile princeps of his Order. He is the admonitor of birds generally, and is in evidence everywhere.

He must not be mistaken for the Slender-billed Tyrant Bird which is the same in colour and markings, but is smaller, more retiring and has a bill proportionately much smaller, nor yet for the Broad-billed Tyrant-Bird which is larger and has a very broad bill; this bird, however, is seldom seen, being very shy and solitary. The Orange crested Tyrant-Bird is also marked the same, but is smaller than the Slender-bill. All these birds have orange-coloured, silken feathers beneath the black feathers on the top of the head and all shew them occasionally; but the latter named more than all, hence its name.

The Pigmy Tyrant-Bird, or Pipitorie as it is called from its persistent note, is like a tiny Kiskadee, but has no corona The Fork-tail was once a common object in Georgetown: the Cotton Bird is still to be seen along the trenches; the Grey-headed, and the Rustic Tyrant-Birds are very common

There are some eighty genera and about four hundred and sixty species.

TYRANT-BIRDS (Colonial). *Tyrannidae.*

Pesseriformes—

Kiskadee Tyrant-Bird	*Pitangus sulphuratus.*
Slender-billed Tyrant Bird	,, *lictor.*
*Small ,, ,,	,, *parvis.*
Broad-billed ,, ,,	*Megarhynchus pitangua*
Orange-crested ,, ,,	*Myozetetes cayennensis.*
Yellow-breasted ,, ,,	,, *sulphureus.*
Pale-yellow-vented Tyrant-Bird (?)	,, *luteiventris.*
Muff Tyrant Bird	*Tyrannus rostratus.*
Grey-headed Tyrant-Bird	,, *melancholicus.*
Scissor-tailed ,, ,,	*Muscivora tyrannus.*
Brown-tailed ,, ,,	*Myriodynastes audax.*
†Solitary ,, ,,	,, *solitarius.*
Scarlet-breasted ,, ,,	*Pyrocephalus rubineus.*
Rustic ,, ,,	*Elainea pagana.*
*White-capped ,, ,,	,, *albiceps.*
‡Olive brown ,, ,,	,, *olivina.*
Small brown ,, ,,	*Mionectes oleaginus.*
Black-and White Tyrant-Bird (Cotton Bird)	*Fluvicola pica.*

White-headed Tyrant-Bird	*Arundinicola leucocephala.*
Pigmy ,, ,,	*Todirostrum cinereum.*
*†Ornate ,, ,,	,, *pictum.*
†Spotted ,, ,,	,, *maculatum.*
*†White-browed Tyrant-Bird (Roraima)	*Mecocerculus leucophrys.*
†The Sea-shore Tyrant-Bird	*Ochthornis littoralis.*
†The Sprightly ,, ,,	*Copurus leuconotus.*
†The Moustached ,, ,,	*Platyrhynchus mystaceus.*
†Red-tailed ,, ,,	*Rhynchocyclus ruficauda.*
*†Yellow-vented ,, ,,	,, *flaviventris.*
†Stripe-faced ,, ,, (?)	*Euscarthmus zosterops.*
†Ruddy Tyrant-Bird (Roraima)	,, *russatus.*
†Helmeted Tyrant-Bird	*Colopteryx galeatus.*
*†Stripe-capped Tyrant-Bird	*Hapalocerus striaticeps.*
†Beautiful-breasted Tyrant-Bird	*Habrura pectoralis.*
†Dark-headed Tyrant-Bird	*Leptopogon amaurocephalus.*
*†Black-fronted ,, ,,	,, *nigrifrons.*
†Fly-eating ,, ,,	*Myiopagis gaimardi.*
†Ruddy-capped ,, ,,	,, *ruficeps.*
†Dusky ,, ,, (?)	*Myiopatis semifusca.*
*†Harmless ,, ,,	*Ornithion inerme.*
†Fierce ,, ,, (?)	,, *acer.*
*†Superb ,, ,,	*Tyrannulus elatus.*
†Slender-footed ,, ,,	*Tyranniscus gracilipes.*
†Short-billed ,, ,, (?)	*Empidagra brevirostris.*
†White-necked ,, ,,	*Legatus albicollis.*
King Tyrant Bird (or Royal)	*Onychorhynchus regia.*
†Bearded Tyrant-Bird	*Myiobius barbatus.*
*†Ruby ,, ,,	,, *erythrurus.*
Roraima Tyrant-Bird (red streaked head)	,, *roraimae.*
†Freckled Tyrant-Bird	,, *naevius.*
†Olive ,, ,, (?)	*Empidonax olivus.*
†Flaming ,, ,,	*Horizopus ardesiacus.*
†The Swarthy Tyrant-Bird (?)	*Planchesia fusca.*

†The Fly King Tyrant-Bird	*Myiarchus tyrannulus.*
†The Bold „ „	„ *ferox.*
?	„ *pelzelni.*
†The Grey „ „	„ *phaeonotus*
†The Striped „ „	*Empidonomus varius.*
*Swallow-fly „ „	*Empidochanes salvini.*
*Ash-coloured „ „	*Sayornis cineracea.*

BARBETS AND PUFF-BIRDS.—These birds derive their name from the barbs or bristles with which their mouths are beset, though they are by no means the only birds thus armed. The Barbets of the colony may be compared with the Kiskadee in size and form, and also as regards their powerful beak: but they belong to a different Order, namely, the *Coraciiformes.* There are two different families: the Bucconinae or "Puff Birds" which are nearly related to the Jacamars, and the *Capitonidae* or "Big-heads," related to the Toucans. The former belong entirely to the New World, the latter are also found in Africa, India and the East.

The feet of all these birds are zygodactyl, that is to say, there are two toes before and two behind. Barbets feed on fruit and berries with occasional insects. They build their nests in holes of trees which they themselves, if necessary, excavate in the decaying wood. They lay white, shining eggs. Their note is generally long, loud, and ringing A species in India is called the "Copper-Smith" on account of the resemblance of its interminably repeated note to the sound of a hammer striking metal. The plumage is often brilliant with contrasts of scarlet, purple, yellow or blue, bright green often prevailing. They are shy, arboreal birds, seldom appearing in the open. There are twenty-eight genera and about two hundred and eighty species, of which forty-five *Capitonidae* and sixteen *Bucconinae* belong to America.

BARBETS—(Colonial.)

***Bucconinae*—**

Collared Barbet or Puff-Bird	*Bucco collaris.*
*Long-billed Barbet or Puff-Bird	„ *macrorhynchus.*
*Dyson's Barbet	„ *dysoni.*

Large-billed Barbet	*Bucco hyperrhynchus.*
*Ord's "	" *ordi.*
Pied "	" *tectus.*
Spotted "	" *tamatia.*
White-breasted (soft-feathered)	*Malacoptila fusca.*
Red-billed Barbet (Solitary)	*Monasa nigra.*
White-rumped Barbet (Swallow-winged)	*Chelidoptera tenebrosa.*

Capitoninae—

Red throated Barbet	*Capito niger.*
*Golden Barbet or Puff-Bird	" *auratus.*

KING-FISHERS.—These birds comprise a well-marked family of which the English Kingfisher may be taken as the type. They are remarkable for their large heads, spear-like beaks and, as a rule, for the gorgeous, and often metallic-like lustre of their plumage. They are divided into two sub-families, the *Alcedininae* and *Halcyoninae*, the latter family called the Wood-Kingfishers, being found as described, and feeding upon insects, reptiles, worms, etc., and only occasionally on fish. The former are expert fishers and have thus given the name to the whole tribe. Sitting solitary and motionless for a long time by the side of a pool or trench they may be seen suddenly to dart like an arrow into the water and seldom do they fail to bring up a struggling victim. The feet are exceedingly small for the size of the bird and are zygodactylous; the short scarlet tongue is shaped like an arrow-head. They lay their globular, shining white eggs in holes of trees or banks of streams. According to legend, Zeus changed Ceyx and Alcyone into Kingfishers, while the father of Alcyone calmed the weather while they formed their floating nest upon the ocean! Their note is generally nothing more than *tcit-tcit* or *tit-it*; but in some species, a loud derisive laugh. There are in all, twenty genera and some two hundred species, of which eleven only belong to the New World.

MOT-MOTS.—Closely related to Kingfishers and the Rollers of the Old World, are the Mot-Mots, all twenty-

four species of which belong to the Neotropical regions. The Houtouli of this colony is a good example. In habits they resemble the Wood-Kingfishers, feeding on insects lizards, etc., and also fruit. The feathers are loose and often beautiful in colour, green or greenish red prevailing. The Houtouli and some other species nibble off the vanes from the two long tail feathers, making them raquet-like. The legs are short and the feet small; and, unlike Kingfishers, they have three toes in front; their tongue is a long, flat, bristle; the beak is serrated. They lay their eggs in holes of trees or banks. Their cry is a muffled note, something like: *mot*, *mot-mot-mot*, *mot-mot*, and sometimes, very loud, like the muffled bark of a dog. They are by no means shy, but this may be due to a want of intelligence.

KINGFISHERS—(Colonial). *Alcidinidae.*

Collared Kingfisher	*Ceryle torquata.*
Belted ,,	,, *alcyon.*
Amazonian ,,	,, *amazona.*
White-and Green Kingfisher	,, *americana*
Rufous-and-Green Kingfisher	,, *inda.*
Pigmy Kingfisher (eye-browed)	,, *superciliosa.*
†Dappled-winged Kingfisher (?)	,, *stictopera.*

MOT-MOTS.

The Houtouli	*Momotus momotus* (or *motmota.*)

JACAMARS—These birds greatly resemble Kingfishers in outward appearance and in their mode of catching their prey. Sitting motionless upon some high branch of a tree, they will suddenly dart down with the swiftness of an arrow upon some insect flying below, and with unerring aim. It will be noticed that their beaks are slenderer and sharper than Kingfishers' and their plumage softer and more brilliantly metallic, being generally coppery or golden-green above and reddish below. They are found in the Neo-tropical regions. On account of the peculiar

brilliancy of their plumage they have been called Large Humming Birds. The sexes are alike. They nest in holes like Kingfishers and like them, lay roundish, shining white eggs. The Paradise Jacamar is characterised by a median pair of long, tapering, tail feathers. The Kingfisher-Jacamar differs from all the others in possessing only three toes, the hallux being absent. There are six genera and twenty-two species of these birds.

JACAMARS—(Colonial.) *Galbulinae.*

Paradise Jacamar	*Urogalba paradisea.*
Green ,,	*Galbula viridis.*
*Red-tailed Jacamar	,, *ruficauda.*
White-bearded Jacamar	,, *albirostris.*
*Bright-vented ,,	,, *leucogaster.*
Brown ,,	*Brachygalba lugubris.*
King-fisher ,, (?)	*Jacamaralcyon tridactyla*
The Great ,,	*Jacamerops aurea.*

TROGONS Trogons are singularly beautiful birds, forming a distinct class They are somewhat hawk-like in form but very different in colouring. Bright, metallic blue or purple above, pale yellow below, with delicate markings of white, black or grey, are common colourings. The feathers are soft and silky and the skin so thin and tender that they easily come off with rough handling; there is no under-down. The tail-feathers are often curiously squared and are often barred or striped, hawk-like, underneath In the Quezal (*Pharomacrus mocinno*) the tail upper coverts extend enormously beyond the rectrices, the two median ones being the longest. The bird is found in Central America and probably not in this colony

The bill is wide at the gape and beset with bristles. The maxilla is notched at the end and both mandibles are often toothed or serrated. The feet are weak and heterodactyl, the second toe being reversed—an arrangement unique among the birds. They live in the thick forest and feed principally upon fruit and insects which they take on the wing Their flight is noiseless and rapid but short and jerky. They are generally silent, but sometimes cluck, whistle or chatter. They lay their roundish eggs of white, light blue, or buff, in holes of trees which they will make or enlarge on a rotten tree or stump. While most of the Trogons belong to America, species, generally of a

more sober hue, are found in Africa, India, China, and the East. That they are ancient forms is shown by the discovery of the *Trogon gallicus* in the lower Miocene of France. The order includes some fifty species, included in five genera.

TROGONS—(Colonial). *Trogonidae.*

Quezal or Long-tailed Trogon (?)	*Pharomacrus mocinno.*
Masked Trogon	*Trogon personatus.*
Green-breasted Trogon	„ *atricollis.*
Purple-breasted „	„ *viridis.*
Blue-headed „	„ *meridionalis.*
Red breasted „	„ *melanurus.*

(*To be Continued.*)

Guarantees for Lime.

The Staffordshire Chamber of Agriculture has called attention to the necessity for farmers getting a guarantee when buying lime. A case was instanced where a parcel of 20 tons of lime was purchased, and was found, on analysis, to be practically worthless for agricultural purposes. The county agricultural instructor expressed the opinion that farmers should not buy lime which contained less than 80 per cent caustic lime.

— "Fertilizers and Feeding Stuffs Press,"
November 21, 1914.

Thomas' Phosphate (Basic Slag).

"The lime contained in basic slag, *i.e.*, Thomas' or Slag phosphate, is itself of considerable value; it supplies what is often a much needed base, and on old grass land in particular, its effect in bringing the soil potash into solution, and in promoting the oxidation of the nitrogenous reserves in the soil is very marked; on tillage land also, the lime is of assistance in improving the texture of the soil."

- A. D. Hall, M.A., F.R.S., formerly Director,
Rothamsted

The Cultivation of Vegetables: III.

By J. F. Waby, I.S.O., F.L.S., F.R.H.S.

Just after the publication of my last notes on the Cultivation of Vegetables the writer of "Notes on Agriculture" suggested that the "Nunewah" or "Loofah" should have been included in the list of desirable vegetables. I do not consider there is much use in giving instruction for cultivating an article which needs no cultivation, one which will grow anywhere and anyhow. The coolies grow it and use it, yes, but I have never heard of anyone else doing so, except for the purpose of obtaining ripe fruits for use in the bath. The young fruits are too bitter for the white man, and I do not think creoles use them. All that is necessary is to dig up a small mound, add a little manure to improve the soil, put in 2 or 3 seeds, give the plants something to climb on, a little water occasionally and the crop will follow.

Had the writer mentioned the other species, the "Ghingee," *Luffa acutangula*, I could have understood that a desirable vegetable had been omitted, for this is one worth growing, being very delicate in flavour and without bitterness. I recall the circumstance of a well-known doctor here who applied to me for a few young fruits of this "Ghingee" which he had recommended to a patient, a well-known official of the colony, who was very ill and needed some delicacy to tempt him to eat. I was fortunate in being able to supply what was needed and they were greatly relished by the sick man. This plant needs a little cultivation and good soil: the rough dealing as with the "Nunewah" is not sufficient: consequently, like other vegetables which need a little attention and don't get it, it is rarely to be met with.

THE "GHINGEE."

Plant it as you would any good vegetable in good soil, with plenty of space on which to climb, free from obstructions and shade and it will do well. Use the fruits when very young, before fibre has been formed; boil them as young squash, and serve hot with a little butter, pepper and salt.

The fruit of the "Nunewah" is smooth and the skin when ripe, peels easily, but that of the "Ghingee" is corrugated with sharp edges, the skin adheres to the fibre and will tear off in small pieces. I believe the Chinese use the fibre of the ripe fruit as soles for shoes and slippers it being tense and springy.

The "Sat-puteah" or "Five-fingered Loofah," *Luffa sat-puteah*. This is another Luffa well worth growing. I had not seen it for many years until I came across it again a short while ago in the Market. It is quite as good as the "Ghingee" The fruit is small, about the size of a medium-sized banana, and grows in bunches, 3-5 together, not singly as in the other two species. Use in the young state before fibre is formed.

THE SWORD-BEAN NOT POISONOUS.

The Sword-bean, *Canavalia ensiformis*.--This bean has been grown in the Botanic Gardens for several years for the purpose of obtaining seed to distribute as a soil improver by green manuring. The plant had the reputation of being unfit for consumption as a vegetable, being supposedly poisonous. There being so many vegetables grown for table use in the Gardens I had no wish to "bell-the-cat" in attempting what was likely to turn out disadvantageous, so I never tried my hand in that direction. A friend in town, who was told of its reputation, asked for a few seeds, grew the plants, when the fruit was ripe used the shelled seeds as a vegetable, both as a side dish and in soup, and pronounced them excellent. There being no baleful after-effects the sinister reputation of the plant was done away with for good so far as the ripe seeds were concerned. But I considered that as the riper seeds were innocuous the young green beans would be so also, and should be tried, as they seemed likely to provide a good green vegetable with little trouble. On coming to reside in town I obtained a few seeds and grew the plants. As soon as the beans were sufficiently large I had them picked, tried them at home, and was delighted with the experiment. For anyone who has little space for growing vegetables this should prove a boon and would give a constant supply for very little trouble. Plant a couple of seeds together in small mounds of good soil and as they begin to grow give a few branched sticks to climb on, or

if a fence is available plant the seeds beside it, giving say, 4-6 feet between the mounds. In a short time the fruits will be produced; pick the beans before the seeds are formed, treat them exactly as French-beans or the "Scarlet Runner," *i.e.*, slice and boil till tender. Five or 6 beans will be sufficient for a good dish. Save a few beans to ripen for another sowing. For large families, or where there are many persons to participate, plant about a dozen mounds. The beans are very prolific and are decidedly worth growing as a vegetable.

Selling Basis of Lime Juice and Oils.

Concentrated lime juice is sold on the basis of its citric acid content. The juice is quoted on the basis of a standard "pipe" of 108 gallons, containing 64 oz. of acid per gallon. A pipe is therefore equivalent to 6,912 oz., or 432 lb. of citric aci.d

A West Indian hogshead of concentrated juice (100 oz. per gallon) contains about 52 gallons, and is equivalent to three-fourths of a standard pipe. A pipe contains 432 lb. of citric acid; a West Indian hogshead 325 lb. In commercial analyses the citric acid is mentioned as crystallised acid, containing only half a molecule of water instead of one molecule, as would be done in the case of ordinary analysis.

—"Bulletin of the Imperial Institute," Vol. XIII.,
No. 1, 1915.

A Good Rubber Tree.

A (Para rubber) tree in the Waterfall garden, Penang, twenty-eight years old, has been tapped yearly since 1896, and has given during the years 1896 to 1913 (inclusive) a total yield of 98 lbs. of rubber, the average for the last three years being just over 13 lbs.

—"Gardens Bulletin," Straits Settlements, 1914, 1,212.

Planting Table: Number of Trees per Acre.

The following table of the number of trees per acre obtained by different planting distances will be useful to readers of "The Journal."

	10	12	14	15	16	17	18	20	21	22	24	30	32	36	40
10	435	363	311	290	272	256	242	217	207	198	181	145	136	124	108
12	363	302	259	242	226	213	201	181	173	165	151	121	113	103	90
14	311	259	222	207	194	186	172	155	148	141	129	103	97	88	79
15	290	242	207	193	181	170	161	145	138	132	118	96	90	82	72
16	272	226	194	181	170	160	151	136	129	123	113	90	85	77	68
17	256	213	186	170	160	150	142	128	122	116	106	85	80	73	64
18	242	201	172	161	151	142	134	121	115	110	100	80	75	69	60
20	217	181	155	145	136	128	121	108	103	99	90	72	68	62	54
21	207	173	148	138	129	122	115	103	98	94	86	69	64	59	51
22	198	165	141	132	123	116	110	99	94	90	82	66	61	56	49
24	181	151	129	118	113	106	100	90	86	82	75	60	56	51	45
30	145	121	103	96	90	85	80	72	69	66	60	48	45	41	36
32	136	113	97	90	85	80	75	68	64	61	56	45	42	38	34
36	124	103	88	82	77	73	69	62	59	56	51	41	38	35	31
40	108	90	79	72	68	64	60	54	51	49	45	36	34	31	27

The method of using the table is simple.

Select in the top horizontal line and on the vertical line on the left the numbers corresponding to the planting distances: follow along the lines until the vertical line cuts the horizontal: and the figure at that point gives the number of trees per acre. Thus 16 x 20 = 136 trees per acre: 32 x 12 = 113 trees per acre: and so on.

A Valuable Cow.

What is claimed to be the champion dairy cow of the world was sold recently in the United States for £1,020, which is believed to be the highest price ever paid for a dairy cow. This cow, Mayrilma—a Guernsey—has a yearly record of 19,673 lb. of milk, containing 1,073lb. of butter fat.

— "Queensland Agricultural Journal," March, 1915.

The Curing and Preparation of Jamaica Ginger.

In November 1914, the Board of Agriculture distributed to certain planters rhizomes of Jamaica ginger for trial on a small scale. Good results attended its cultivation when grown under favourable conditions.

Jamaica ginger, as is well-known, is the best grade of ginger on the market at the present day, realising a price of 55/- to 75/- per cwt.

The following information regarding the curing and preparation of the product, issued by the direction of Sir William Robinson, K.C.M.G., for the use of District Agricultural Boards in Trinidad, is here published for the use of those who are engaged in its cultivation:—

"Ginger is propagated by the smaller pieces, prongs, or protuberances of the root, each of which throws up two different stems; the first bears the leaves, and rises to the height sometimes of three feet or upwards, but its usual growth seldom exceeds 18 inches. It thrives best in a rich cool soil; therefore one which has been recently cleared from wood is well adapted to the culture of it, more especially as it is supposed to be a great impoverisher of land. In such a soil it grows so luxuriantly that a hard or large spreading root will weigh near a pound. It is, however, remarked that what is produced from a clayey, tenacious soil shrinks less in scalding, while such as is raised in richer, free, black moulds loses considreably in that operation. The land intended for the cultivation of it is first well cleaned with the hoe, then slightly trenched, and planted about the month of March or April. It attains its full height and flowers about August or Septem-ber, and fades towards the close of the year. When the stalk is entirely withered the roots are in the proper state for digging This is generally performed in the months of January and February After being dug they are picked, cleansed, and gradually seethed 'or ' scalded in boiling water; then spread out and exposed every day to the sun till sufficiently dried; and after being divided into parcels of about 100 lbs. each, they are packed in bags for the market; this is called the *black ginger*. The manner of scalding the roots is as follows:—A large pot or copper is

fixed in the field or some convenient place, which is kept full of boiling water; the picked ginger, being divided into small parcels, is laid in baskets, and plunged in the water; where it is suffered to stay for the space of 10 or 15 minutes, and then spread on a platform for drying; but care is taken during the process to change the water so soon as it becomes much impregnated with the juices of the root.

"WHITE GINGER."

The white sort differs but little from the black roots. The difference arises wholely from the methods of curing them; the white is never scalded, but, instead of this easy process the 'roots' are picked, scraped, and washed one at a time, and then dried; all which requires too much pains and time for any real advantage to be gained in the properties; though, being made more agreeable to the eye, the price of the white is much higher at market. When the root is intended for a sugar-preserve, it is dug while tender and full of juice (the stems at this time rarely exceed 5 or 6 inches in height), carefully picked, washed, and afterwards scalded, till it is sufficiently tender; it is then put in cold water, and peeled and scraped gradually. This operation may last three or four days, during which it is commonly kept in water, and the water frequently changed for the sake of cleanliness as well as to extract more of the natural acrimony. After this preparation it is laid in unglazed jars and covered with a thin syrup, which in two or three days is shifted and a richer put in; this is sometimes removed for a third or fourth, but more than three are seldom requisite. The shifted syrups are not lost, for in Jamaica they are diluted with water and fermented into a pleasant liquor called 'cool drink,' with some mixture of the chaw-stick, lignum vitae, and sugar." —(Long's Jamaica, p. 700.)

THE JAMAICAN METHOD.

Mr. W. Bancroft Espent, F.L.S., writes regarding the curing of Jamaica ginger, in 1886, as follows:—

"The method pursued in Jamaica is extremely simple. The ginger being about 10 months to 1 year old from the time of planting, and having arrived at maturity begins to wither, the leaves getting yellow and shrivelled. The roots are then dug up, *great* care being taken not to *bruise* them. If the epidermis (skin) of the root is injured, it

discolours the product. After the roots are dug, they are carefully trimmed with a sharp penknife and picked and allowed to dry in the air for a few hours until all the accompanying earth can be rubbed or wiped off with a soft cloth. The cleaned roots are then placed a few at the time in boiling water and scalded, and the epidermis is scraped off with a sharpened bamboo like a very narrow flexible paper knife. As soon as scraped they are placed in the sun until apparently free from dampness. Gradual drying results in a better product than quick drying. After this the drying is continued for a few hours a day in the morning sunshine and in air-drying sheds until after 8 to 12 days the fingers break off sharp and clear. The ginger is then cured and should be sorted, all of one colour being kept separate, and the large again separated from small. The water used in scalding should be clear and free from iron or excess of lime."

Mr. J. H. Hart also writes from the Botanical Department, Jamaica, in the same year as follows:—

"Jamaica ginger is cured in two ways, one in producing the commodity known as 'uncoated ginger,' the other 'coated ginger,' both saleable in British or American markets.

To produce the 'uncoated ginger,' which is that prepared for medicinal use, the fresh rhizome is simply scraped, washed, and then well dried in the sun. When thus prepared it should have a pale buff hue, a striated and fibrous surface, should break easily, exhibiting *a short farinaceous* fracture with numerous bristle-like fibres. It is often further prepared by bleaching, being subjected to the fumes of burning sulphur, or immersed in chlorinated lime. Much of that sold in England is coated with calcareous matter, either sulphate or carbonate of calcium. These bleaching and covering processes are, however, usually performed after the article reaches the first market.

'Coated ginger' is prepared by being dried in the sun without removing the epidermis, which causes the article to assume a crude and wrinkled appearance.

The rhizomes should be collected after growth is made for the season, which may be known by the leaves turning yellow and gradually drying up."

The Climate of the Principal Rubber Countries.

In an article on the climate of the principal rubber producing countries, W. van Bennelen (In "International Rubber Congress met Tentoonstelling," Batavia, September, 1914. "Rubber Recueil," Amsterdam: J. H. de Bussy 1915, pp. 145-166, pl. 1), describes the climate of the Amazon and Congo basins, Ceylon, Malacca, Sumatra, Borneo. and Java as follows:—

It is stated in general that "the climate of these countries is purely tropical; that is to say, warm, damp, and equable. The temperature in the plains is 25 to 27° C., (77 to 80.6° F.) declining above the sea level at the rate of about 0.6° for every 100 meters (1° F. for every 300 feet). The percentage of moisture in the air is great, and as a result the pressure of aqueous vapour is proportionately high (± 20 mm.) and the rainfall is more abundant (2,000 mm. = 79 inches and more per year); above all, however, its evenness is the most conspicuous feature of the climate. The yearly rise and fall in temperature amounts to only a few degrees and the daily difference far exceeds the yearly, though even that is not excessive. Periods of drought are seldom of longer duration than two months. The force of the wind is slight, and storms are practically unknown; there are merely the gusts which are forerunners of the many thunderstorms, and these can be pretty violent."

The Medical Report of the United Fruit Company.

Not many large British business concerns are known to issue Annual Reports, and it is certainly a sign of progressiveness that the American United Fruit Company does so. As a matter of fact. few British Colonial Governments have, until quite recently, published anything so good. The operations of the Fruit Company evidently cover a very large area in the tropics. and this report contains several observations which will interest students of tropical medicine and sanitation.

—"Science Progress," July, 1915.

The Prospects of *Hevea* Cultivation in the Colony.

The following Minute on the present position and prospects of *Hevea brasiliensis* in British Guiana has been issued by His Excellency the Governor:

"Mr P. Drayson, who has been manager of Plantation Vreed-en-Stein for a short time, has made certain statements regarding the cultivation of *Hevea braziliensis* (the Para Rubber tree) in British Guiana, which are likely, if not quickly and authoritatively contradicted, to cause considerable injury to the prospects of that industry.

"Before commenting on his statements, I may remark that for some time the Government has issued warnings against planting rubber in the coast belt of the colony within a short distance of the sea where the sub-soil is sour or saline. As regards Pln. Vreed-en Stein itself, I have visited this plantation on several occasions and I can speak from personal experience, acquired in 21 years' residence in the Straits Settlements where I saw the rubber industry grow up, that where the seedlings have been kept clean and properly cared for, they have shown growth quite equal to the average in the East.

"I have seen plantations of Para rubber in the East the trees in which, when over 10 years old, were still not much thicker than the butt of a fishing rod, but that was where they had been neglected and had been allowed to become choked with grass and weeds and secondary growth—the same conditions obtain here

"There are certain soils also in the East where Para rubber will not flourish. That is the case here.

"At my first visit to Pln. Vreed-en-Stein I went over the whole estate and I saw a few trees, the only trees then over 4 years old on the plantation, which showed extraordinarily rapid growth for the ages given me

"I have not seen a single rubber estate in this colony where the same care is given to the cultivation

and keeping clean of the trees as is almost the universal practice in the East. The fact is that Para rubber cultivation is not believed in yet in this colony, and that proprietors very often are unable to provide the sum required to ensure rapid growth and early maturity of the trees. There are few plantations in the East that tap their trees at 4 years old, and where that is done, it is only a small percentage of the trees that are tapped,—trees that are exceptionally developed—and only where money is much wanted in order to enable the estate to be carried on.

"It may be quite true that some proprietors,—the instance referred to by Mr. Drayson is that of a proprietor who has just purchased his estate—have recently cut down Para rubber trees. The same thing occurred in the Federated Malay States. The first planter who planted up any considerable area in Para rubber cut down some hundreds of acres of these trees after they had attained a considerable size, because the shade of the trees was damaging the inter-planted coffee. Within a very few years of his having done this, the remaining portion of his Para rubber cultivation was worth over £200 an acre, the portion left in coffee was worth nothing; and the coffee cultivation was abandoned and the land replanted in Para rubber.

"That land now forms a portion of the properties of the famous Linggi Estates, the premier Rubber Company in the world.

"The statistics published by Government authority of the results obtained on the Government plantations in this colony and on private plantations, are absolutely correct. They have been carried out under the close personal supervision of Mr. C. K. Bancroft, who served in the Agricultural Department of the Federated Malay States for some years, the country which is the most successful, and the chief, Para rubber planting country in the whole world. He acquired there an expert knowledge of the methods of growing and tapping and curing "Plantation" rubber. Previous to his arrival in this colony the results of experimental tapping here were very unsatisfactory, but under his supervision, owing to the introduction of

the proper methods, it has been clearly proved that the yield of trees here is fully equal to the yield in the Eastern plantations.

"It has also been proved that under suitable conditions of soil and situation the trees grow as freely and quickly here as in the Federated Malay States. This colony has a width of over 200 miles and a depth of 300 miles. It possesses large areas of soils of various descriptions and large areas where the rainfall is as well spread over the year as in the Malay Peninsula. It is in the same latitude as the Federated Malay States and it is ridiculous to contest the fact that there are tens of thousands of acres here well adapted for the planting of *Hevea brasiliensis,* and it must not be forgotten that *Hevea brasiliensis* is a native of South America and that other species of *Hevea* are indigenous, although the *Hevea* which is proved *facile princeps* as a producer of rubber is not common.

"But when Para rubber, as other, cultivation is carried on under expensive European management, it is necessary that a fairly large area should be planted in order to spread the cost of costly superintendence. Unfortunately in this colony every Company that has undertaken the planting of Para rubber has been hampered with insufficiency of capital or by the doubt in the minds of the proprietors as to the real value of the cultivation or both.

"On the question of the cost of rubber tapping the Government have given the results obtained by the Government Officers. The Government management is admittedly seldom as efficient or cheap as commercial; but the results achieved by the Government show that even at 2 shillings a pound, Para rubber cultivation if carried out on a sufficiently large scale and with sufficient capital, should prove very remunerative.

"Statements such as those that were published in *The Daily Argosy* on the 29th November, give an entirely wrong impression of the prospects of the industry.

"All trees and plants cultivated are subject to the attacks of disease and insect pests but up to the pre-

sent *Hevea braziliensis* has shown itself especially resistent to the attacks of disease and insects and to have great powers of recuperation. There is no reason to fear that the diseases mentioned by Mr. Drayson as now prevalent in some districts will prove more formidable than others which have been successfully fought and conquered here and elsewhere. The Director of Science and Agriculture has informed me he is certain Mr. Bancroft can tackle it successfully."

WALTER EGERTON.

2nd December, 1915

The Role of Chlorophyl.

A series of four maize plants were cultivated in solutions which, for the first two acting as controls, were of ordinary strength, and for the last two ten times as strong, approximately 3.4 parts of soluble elements per 1,000. The amount of water evaporated by each plant was measured, and on the twentieth day this loss of water was made good by addition of the respective culture solutions, the strength for plants 3 and 4 having reached approximately 6·2 parts per 1,000. From this date, these two plants began to lag behind the controls, and six days later the terminal leaves of plant 4 were chlorotic. Comparing one control and one experimental plant, it was found that on the twenty-fourth day the control evaporated twice as much water as the other, the expenditure of heat being, therefore, 180 and 90 Cal. respectively. This difference could not be attributed to differences either in the chemical work of the plant, to external conditions, or to difference in leaf surface of evaporation. It could only come from calorific energy due to the transformation of luminous radiations by the chlorophyl. A diminution of the activity of a plant must consequently produce a decoloration of its green organs, and this was found to occur in the case of plants 3 and 4, the chlorosis being the means by which the plant protects itself against an exaggerated rise in temperature.

In the case of the control plant on the day mentioned, when the expenditure of heat due to the evaporation of the water was 180 Cal., the increase in dry weight was 2 grams. For this gain in weight, about 8 Cal. were absorbed. The author considers that the difference comes from the chlorophyl, and that it is rash to attribute to this substance any immediate action on the chemical changes taking place during the assimilation of carbon. The rôle of the pigments of the higher plants is purely physical.

—"Journal of the Chemical Society," July, 1915.

Presentation to Mr. L. S. Davis.

THE departure for the seat of war of Mr. Lionel Stuart Davis, Second Assistant Analyst of the Department of Science and Agriculture on Saturday, August 21st, was made the occasion of a presentation to him of a token of appreciation from the Director and Officers of the Department, which took the form of a purse of £18 4s. 4d., subscribed to by every member of the staff from the Director downwards.

The presentation was made at a very pleasing little ceremony, held at noon on the 21st, only an hour or two before the departure of Mr. Davis with the British Guiana Contingent, of which he was one of the first to volunteer as a member. There were present the Director (Prof. J. B. Harrison, C.M.G., M.A.,) the Assistant Director (Mr. C. K. Bancroft, M.A, F.L.S.,) Messrs. G. E. Bodkin, B.A., R. Ward, A. Seton Milne, M.R.C.V.S., J. Williams, F.C.S., R. Service, E. S. Christiani, K. D. Reid, L. D. Cleare, jnr., F.E.S., C. W. Anderson, H. B. France, and C. Cameron, Misses M. Van Nooten and Goring, and the Editor of "The Journal." Mr. J. Wood Davis, father of Mr. L. S. Davis, also attended at the special invitation of the Director.

Professor Harrison, in making the presentation, alluded to the devotion to duty which Mr. Davis had shown during his period of service in the Department of Science and Agriculture, as well as in his military capacity as a member of the colony Artillery. He was sure that Mr. Davis would keep up his reputation for hard work and a keen sense of duty, and live up to his own high standard, as a representative of the colony with the British Guiana Contingent which was now to take an active part in the defence of the Empire.

Mr. Bancroft, who followed, spoke of Mr. Davis's prowess in the world of sport, and especially as a footballer and cricketer in the ranks of the Artillery Sports Club

Mr. Reid, as one who had worked in close personal contact with Mr. Davis in the Laboratory, struck a more intimate note, and Mr. Davis (who was much affected and spoke with much emotion) in acknowledging the presen-

tation and the kind things said about him, assured his hearers that they might be confident that he would in no way disgrace them, but would do his duty in whatever shape it might present itself to him.

Mr. J. Wood Davis, who was also much moved, said that the recipient of the presentation was his only son and that it had been a great struggle for his wife and himself to part with him. They saw, however, how determined the lad was to serve his King and Country, and they were satisfied that they were doing the right thing, at whatever cost to themselves, in letting him have his way. He concluded with a warm personal tribute to Professor Harrison for the kindly interest he had taken in his son during the considerable number of years in which the lad had been an officer in his Department.

A group photograph was subsequently taken by Mr. Williams.

Racial Effect of the War.

For my part, I am inclined to think that the most potent factor is probably the tendency to revert to the racial mean, and this may well explain how nations have passed with little change through peace and war. If the peoples of our continent were really to become weaker, more sluggish, more stupid, more enslaved to preconceived ideas, then in truth we might despair of any ultimate good arising out of the present war. But I see no real cause to fear degeneracy. On the contrary, we may hope for an advance, not perhaps in racial qualities, but in the comprehension of our environment. After terrible carnage, the iniquity of the wars of religious persecution was at last realised. So we may hope that this conflict will lead ultimately to some further extension of the realm of justice in international affairs.

—A. G. Thacker, A.R.C.S., in "Science Progress," July, 1915.

Meeting of the Board of Agriculture.

A MEETING of the Board of Agriculture was held on 8th June, 1915, His Excellency the Governor (Sir Walter Egerton, K.C.M.G.,) presiding.

On the motion of the Chairman (Professor J. B. Harrison, C.M.G., M.A.) seconded by Mr. J. Gillespie, a motion was passed recording the regret of the Board at the death of Mr J. Monkhouse, who had been connected with the Board for upwards of 12 years, and its deep sense of the loss the colony had sustained.

REPORTS.

Among the reports submitted were:—

That owing to the large stock of Rubber plants on hand it had been decided to sell rubber stumps at $12 per thousand.

That by Ordinance No. 7 of 1915 the registration of Veterinary Surgeons had been transferred from the Medical Board to the Veterinary Committee of the Board of Agriculture.

That the Permanent Exhibitions Committee had reported to the Board that the Committee had placed in the British Guiana Museum at a cost of $70, a glass case with the object of exhibiting representative specimens of the colony's industries and that representative sets (of 26 samples) of named colony woods had been prepared for sale. The price per set was 50 cents.

That the rubber yields at Issorora and Christianburg during the period November, 1913—May, 1915, had been 900 lbs. and 112 lbs. respectively.

That from May, 1913 to April, 1914, 27,613 seeds of the African Oil Palm (*Elais guincensis*) had been imported but only 1,293 had germinated—a percentage of 4.03—and that of 894 local seeds sown only 29 germinated—*i.e.*, 3.2 per cent. During the period July, 1914—April, 1915, 691 plants had been sent to Clonbrook, Onderneeming and the Hills Estate.

AREAS UNDER CULTIVATION.

The Chairman mentioned that owing to the objection of several proprietors to give correct returns of areas under cultivation when required for compiling the annual agricultural statistics, great difficulty was experienced in properly compiling the returns. To obviate this he moved that under Section 9 (e) of the Board of Agriculture Ordinance, 9 of 1910, regulations be made providing for the collection of agricultural statistics. Mr. Gillespie seconded and the motion was carried unanimously.

The Chairman submitted a "Guide to the Botanic Gardens" prepared by Mr. J. F. Waby, I.S.O., before his retirement from the Department of Science and Agriculture. He thought that a guide was a necessary publication for the convenience of visitors, but he regretted that there was no funds available for the publication of such a work The matter was referred to the Executive Committee.

The Chairman mentioned, with regard to the potentialities of the Ginger Lily (*Hedychium coronarium*) as a raw material for paper making, that it was hoped to send a shipment to England for trial.

THE MODEL GARDENS.

The Chairman intimated to the Board that at their last Annual Session, the Combined Court deleted from the Estimates of Expenditure the sub-vote for the maintenance of the Model Gardens. He regretted that action and considered it the most retrograde step in agricultural matters that had been taken for a long time. He presented the report on those gardens which he had prepared for the Government.

The President and Mr. Clementi pointed out that the members of the Court were apparently under a misapprehension when they deleted the item, the members thinking the item related to school gardens.

The Chairman then moved that the items necessary for carrying on the gardens—which should in future be designated "District Gardens"—be included in the next draft estimates. Mr Clementi seconded, and the motion was agreed to unanimously.

AFFILIATED SOCIETIES.

It was decided that His Excellency the Governor be recommended to award grants of affiliation to the following Societies according to the Board's scale:—

Association.	No. of Members.	Grant.
Buxton and Friendship Farming Association	36	$12.50
Victoria-Belfield Agricultural Society	37	12.50
Beterverwagting and Triumph Agricultural Society	56	17.50
Wakenaam Farmers' Association	29	10.00
West Bank Farmers' Association	26	10.00
		$62.50

The following grants were similarly recommended:—

West Bank Farmers' Association for Agricultural Show in 1915	$150.00
Model Exhibits at West Bank Show ..	30.00
School Garden Prizes at West Bank Show	25.00
Contingencies	12.50

THE ANTHRAX OUTBREAK.

The Chairman reported that since last meeting, Anthrax had broken out on several areas on the East Coast, Demerara. He detailed the action taken by the Veterinary Committee to combat the epidemic. Supplies of vaccine and syringes for inoculating animals against Anthrax had been obtained, and up to the time of speaking about 8,300 animals had been inoculated. A meeting of the planters of the East Coast had been convened and held at the office of the chairman; and it was decided, as a basis for fighting epidemics, that each plantation should be held responsible for its own quarantine and should have resident inoculators—the Board stocking supplies of vaccine for sale to planters and stock farmers and authorised inoculators. This had been done. The epidemic was on the wane; and the district was already practically free from the disease.

After discussion, it was decided that any restrictions imposed on a district be not removed until after the lapse of three months from the occurrence of the last suspicious case.

The Chairman reported that the colony was free from Swine Plague and Swine Fever; but that since last meeting, the Veterinary Committee had dealt with an occurrence of contagious pleuro-pneumonia on the East Coast, Demerara.

It was decided to confirm the Order of the Veterinary Committee, dated 5th May, 1915, authorizing the Chairman to give written permission to persons to drive or ride animals in or out of an infected area.

On an application from the Rev. Father C. B. Dawson, S.J., M.A., permission to shoot wild birds in or near Georgetown was granted to the R.A.C.S. Museum attendant, with the distinct understanding that no birds in the Botanic Gardens be shot.

The Board then adjourned *sine die.*

A Letter from the Front

How much the wretched payment given to men of Science in this country is exercising their minds may be gathered from a letter which we have received from a very capable junior worker now at the front. He says: "I have been hoping that the war might have as one good result the better treatment of the scientist in England, but judging from the Aniline Dye affair, as I read of it in the papers, things are, if anything, a little worse than ever, and the Government will make no attempt to utilise the scientific ability of the country, neither will it give the scientist any opportunity of working out its own salvation.

—"Science Progress," July, 1915.

Hints, Scientific and Practical.

Tension and Surface Capillarity.

THE existence of attraction between the molecules causes the free surface of any liquid to become a sort of stretched elastic film, in tension itself, and exerting a certain pressure inwards when free. The molecules within the liquid are equally attracted in all directions by the surrounding molecules, and are therefore in equilibrium; the molecules on the surface, having nothing on one side, are only attracted inwards, and so, as a whole, exert a pressure on the liquid similar to that which would be caused by a stretched elastic skin over the liquid.

The existence of this force of "surface tension," as it is called, may be demonstrated by many simple experiments, *e.g.*, by the familiar fact that a clean needle will float when placed carefully on the surface of water; or, by the fact that a portion of any liquid, so small that the force of gravity on it is not large compared to the molecular forces, immediately assumes the spherical shape. Of all figures, a sphere has the smallest surface in proportion of its contents, *i.e.*, the stretched film on the surface of a drop of liquid shrinks as far as it can until the liquid is packed into the smallest possible compass, which must be the form of a sphere.

When a liquid and a solid are in contact, the form of the surface and the resulting pressure or tension depend on whether the liquid "wets" the solid or not. For example, if a series of very fine or "capillary" glass tubes are dipped into water and mercury respectively, the water will rise up the tubes in inverse proportion to their diameters, the mercury, which does not wet the glass, will be correspondingly depressed.

The surface of a liquid may exert either a pull or a pressure on the liquid within, according to the curvature of the surface, and the greater the curvature the greater will be the force exerted. It is this tension of the surface

film which causes movements of water in soil, other than those due to gravity: for example, if a flowerpot stands in a shallow dish of water the whole of the soil within the pot is kept moist: or if water is poured on to dry soil it is seen to work outwards through the soil, the water advancing from particle to particle as it wets them, just in the same manner as it rises up the capillary tubes. When a soil is saturated the whole pore space is filled with water; if this soil be allowed to drain, some of the water is pulled away by gravity, but much remains clinging round the particles in the stretched film condition, the tension in the film balancing the pull due to gravity. Perhaps the best illustration of the state of affairs in a wet but drained soil may be obtained by linking a series of toy balls together and then dipping the whole into oil. When the oil has ceased to drip it will be seen that every ball is covered by a thin film of oil, and that between the balls there is a layer of oil, much thicker in the lower than in the upper layers. The whole surface film is equally stretched, but the stretching in the upper layers is largely due to the pull from the oil below, while in the lowest layer of all the whole tension exerted by the stretched film is devoted to holding its own thick film of oil. If oil be taken away at any point, the curvature of the film, and therefore the tension of the surface in that region, is increased: a re-adjustment then takes place till the stretched film regains the same tension everywhere, which is effected by a motion of the oil to the place where the tension has been increased. If the withdrawal of the oil be continued, the film round the balls becomes thinner and thinner: the more it is stretched, the more closely it clings to the surface, so that the removal becomes progressively more difficult; at last the film becomes so much stretched that it ruptures and reunites again over a smaller surface, hence with a diminished tension. The rupture naturally takes place where the film is thinnest, on the top layer of balls, which become more or less "dry," while the lower balls are still surrounded by their film.

Just in a similar way water will always move in a soil from a wet to a dryer place till the film surrounding the particles is equally stretched throughout.

—A. D. Hall. M.A., F.R.S., in "The Soil."

The Toxic Effect of Grass on Trees.

THE facts relating to the effect of grass on trees can leave very little doubt that the action is due to some toxic effect, at any rate when this term is used in a wide sense. The tree is not deprived by the grass of the food or water necessary for its welfare; these may be present in abundance but is is incapable of utilising them: this is characteristic of a toxic action. Long before all the evidence here alluded to was obtained, such a conclusion was the one arrived at and to those who have had trees suffering from grass constantly before them, during many years, it would be difficult to arrive at any other. A toxic action, however, does not necessarily mean that the grassroots excrete some substance which is poisonous to the tree: there is a considerable amount of debris from the roots of grass while it is growing, which on decomposition might form substances poisonous to the tree-roots; or the poisonous effect might be due to an alteration in the bacterial contents of the soil.

Independently of anything coming from the grass-roots or resulting from their growth, it seemed possible that the grass might abstract something from the soil and alter the proportions of the constituents remaining so as to render the soil virtually toxic. This suggestion, however, has been negatived by some recent experiments in which the grass was grown in such a way that it was impossible for it to draw anything out of the soil in which the trees were growing. These trees were planted in pots and the grass was grown in movable trays resting on the soil in the pots; the trays were perforated to allow of drainage from them down to the trees but the holes were covered with fine gauze to prevent the grass roots from passing through and thus there could be no passage of water upwards from the pots to the trays. Yet in spite of this entire separation of the grass from the tree, the grass-effect was still very noticeable and caused a reduction of growth amounting to some 25 per cent. These experiments have since been extended to a study of the effect of grass on other plants besides trees and in every case examined up to the present, a similar action has been observed: in the case of barley the reduction of growth amounted to 15 per cent.; in that of tomatoes to 46 per cent.; in that of mustard to 58 per cent. and in the case

of tobacco to 71 per cent. One other important point in connexion with these experiments should be mentioned. that when the grass is grown in trays as in the preceding experiments and the washings. instead of being allowed to pass immediately to the tree-roots. are left for some time exposed to the air before being used on the tree, their action, instead of being hurtful. is decidedly beneficial; apparently the toxic ubstance is oxidised and converted into plant-food

The proposition which has been made to account for these facts—it cannot at present be termed more than a proposition—is that the growth of grass and probably also of other crops, give rise, either directly or indirectly, to the formation of some substance in the soil which is toxic towards plant-growth but which, on oxidation becomes harmless and when oxidised serves to render the soil richer, probably both in organic matter and nitrogen. While the grass is actually growing, there would be a continuous supply of this toxin, which would prevent the plants from benefiting from the increased richness of the soil; but as soon as the grass were removed, the production of toxin would cease and the previously grassed soil would be found to be more fertile than soil which had never had grass growing in it. This is in accordance with the behaviour of trees in soil from grassed and tilled land. as mentioned above; the accumulation of nitrogen in grassed land is a fact which has been known now for many years. It is probable, however, that no soil would ever be quite free from the toxic substance, if such exist, which is produced by the growth of grass.

—A. D. Hall, M.A., F.R.S., in "The Soil."

Osmosis in Plants.

THE passage of the dissolved substances into the plant takes place by the purely physical process of osmosis, the walls of the root-hairs (which consist of single elongated cells) acting as semi-permeable membranes through which water or salts will pass independently, according to the relative concentration of the solutions inside or outside the cell. Should the cell sap be more concentrated than the soil water outside, pure water will pass through the wall until a certain osmotic pressure (causing turgor in the plant) is

reached, which varies with the concentration. If, on the contrary, the soil water become more concentrated than the cell sap, water will leave the cell, the plant will become flaccid, and even die if the withdrawal of water be too great. It is in this way that plants become "scorched" or "burnt" by too concentrated solutions of any kind of soluble salts, such as are formed when a little soluble manure, salt, etc., falls upon the surface of a leaf.

Not only will water pass in or out of the cell, but an equilibrium will be attained between the cell sap and the external soil water for each constituent present in the latter. If, for example, sodium or potassium chlorides be present in solution in the external soil water, both will continue to diffuse through the cell wall until their respective concentrations are the same within and without the cell. If now the potassium compounds be withdrawn from the solution within the cell by the living protoplasm in order to take part in the various vital processes requiring potassium, there will be a fresh influx of potassium until the old equilibrium within and without is restored. It is in this way that the apparent selective action of a plant takes place; as a rule, sodium compounds are more abundant in soil water than salts of potassium, yet the ash of the plant will be found much richer in potassium than in sodium. Similarly again the ash of any particular plant will maintain a fairly constant composition although grown on soils of widely differing character. The selective power resides in the living cells themselves; all substances dissolved in the soil water diffuse through the walls of the root hairs into the plant, but will not continue to accumulate therein unless they are utilised and withdrawn from solution by the protoplasm.

Further it is not necessary to consider that the plant takes up the various salts presented to it as wholes; the process of diffusion until equilibrium is attained, of withdrawal by the protoplasm and consequent renewal of the process of diffusion, takes place for each acid or base independently of the others. As a rule, a plant growing in a nutrient medium containing nitrates as sources of nitrogen, will withdraw an excess of acid and render the solution alkaline, but cases also occur when the medium becomes acid during growth because the plant takes more base than acid. According to modern views of solution, we

must regard the soil water as a highly ionised solution, and each particular kind of ion establishes its own conditions of equilibrium within and without the cell.

—A. D. Hall, M.A., F.R.S., in "Fertilisers and Manures."

General Plant Sanitation.

In olden times diseases of plants were regarded as 'visitations,' and allowed to rage unchecked. In seasons favourable to their development, their ravages caused widespread damage and, in some instances, the almost total ruin of a country; and only the advent of less favourable years brought relief. Even after it had been proved that plant diseases were due to the action of specific organisms and that some steps could be taken to combat them, little improvement resulted at first, because, in the majority of cases, nothing was done until the disease had obtained so strong a footing that nothing could be done successfully at any reasonable cost. The fungus of coffee leaf disease (*Hemileia vastatrix*) was recognised to be a very destructive pest in 1869, but it was not until ten years later that active measures were taken against it. There is little doubt that much of this delay was due to a reluctance to admit that any disease existed; and it is only within the present century that public opinion in planting countries has come to understand that plant diseases are as inevitable as those of men and animals. Less than ten years ago the issue of a circular on a disease of tea brought letters, either abusive or supplicatory, pointing out the supposed injury which such publication inflicted upon the industry; but at the present day similar circulars may be published every month without exciting any such response.

This acknowledgement of the inevitability of disease leads immediately to a recognition of the fact that it is necessary to be always on the alert to observe any abnormal or suspicious appearances, and to have inquiry made into them at the earliest possible moment. Speed is an essential factor in the treatment of diseases, and to deal with any one of them successfully it must be attacked in an early stage. In *Hevea*, at least, this proposition is thoroughly understood; and there is little fear that any disease will be allowed to proceed unchecked or unobserved in Eastern

plantations, so long as the present vigilance of estate superintendents is maintained. Of course this implies that the observer has a full knowledge of what is normal in Heavea . . . . . At present many trees are sacrificed unnecessarily bcause the planter thinks they may be diseased, and sends them in for examination: still, this is erring on the right side.

But though the recent advance of public opinion in this respect has been extraordinarily rapid, it still falls short of what is absolutely necessary. The continued study of plant diseases has shown what conditions are favourable to their development, and consequently what precautions should be observed if they are to be avoided or minimised as far as is humanly possible. In short, such knowledge enables us to advance from the idea of remedial measures to that of preventive measures. It is no longer permissible to adopt systems of planting or methods of cultivation without considering their probable effect when diseases arise; and in the light of our present knowledge, that effect can in many cases be predicted with a close approximation to certainty. The pathologist should be consulted beforehand, not five or six years afterwards, when some disease has already appeared; and in the absence of any such consultation he would fail in his duty, if he did not point out how new or old planting practices tended to promote disease.

—T. Petch, B A , B.Sc., in "The Physiology and Diseases of *Hevea brasiliensis.*"

Science and the Truth.

Science is not only a fairy godmother to humanity: she is herself a goddess whose great religion and commandment to all is to think the truth. To her and, we believe to the vast majority of her genuine votaries, the whole system of party politics is based upon a false political hypothesis and is conducted by means of wilful distortion of facts and prepense employment of the lying argument; and we fear that a nation which indulges in this evil must certainly have sunk to a somewhat low intellectual level.

—"Science Progress," July, 1915.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported from January 1, to September 30, 1915. The corresponding figures for the three previous years are added for convenience of comparison.

Product.	1912	1913.	1914.	1915.
Sugar, tons ...	30,881	37,720	52,295	63,795
Rum, gallons ...	1,502,041	1,685,081	1,949,135	2,933,524
Molasses, casks ...	906	762	832	...
Cattle-food, tons ...	3,110	5,313	1,131	1,353
Cacao, cwts. ...	102	355	371	519
Citrate of Lime, cwts.	.4	6	49	99
Coconuts, thousands	940	528	1,516	1,515
Copra, cwts. ...	963	745	1,164	1,591
Coffee, cwts. ...	1,225	727	2,132	1,537
Kola-nuts, cwts. ...	...	2	4	2
Rice, tons ...	2,365	5,673	1,711	7,004
Ricemeal, tons ..	1,184	1,651	213	232
Cattle, head ...	413	678	951	460
Hides, No. ..	2,971	4,026	3,706	2,703
Pigs, No. ..	997	1,274	999	856
Sheep, head ...	61	22	131	4
Balata, cwts. ...	2,180	5,949	7,740	10,125
Charcoal, bags ...	50,974	43,761	54,327	42,786
Firewood, Wallaba, etc., tons ...	7,202	6,598	8,189	6,395
Gums, lbs. ...	3,041	1,515	886	...
Lumber, feet ...	155,423	425,734	241,229	134,592
Railway Sleepers, No	4,046	6,718	6,127	1,056
Rubber, cwts ...	1.8	5	7	17
Shingles, thousands	1,645	2,020	1,639	1,509
Timber, cub. feet ...	244,940	391,683	173,130	101,987

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American Enterprise.

THE beginning of the year 1916 saw the foundation of an enterprise which should have far-reaching results. This was the establishment of a Tropical Zoological Research Station in British Guiana by the New York Zoological Society The objects and organisation of the work are best put in the words of the official organ of the New York Zoological Society—the "Bulletin"—which says:—

"Early in January, the New York Zoological Society will embark upon a new scientific enterprise of a most interesting character Mr. C. William Beebe, Curator of Birds, accompanied by three assistants, will sail for British Guiana, for the purpose of establishing in Georgetown, the colonial capital, a tropical zoological station, on lines absolutely new, so far as we are aware. The choice of a location has been made chiefly with reference to the amount of animal life available within a radius of 500 miles.

"The prime objects of the enterprise are two in number. The first is to secure ample facilities for studies of the evolution and life histories of birds, and various problems of avian development that can be studied successfully only

with the aid of living material fresh from the jungle. This is no effort to make a catalogue of the species and subspecies of the birds of the Guianas, or to make collections of skins Mr. Beebe proposes to go back as far as possible toward the origin of the Class Aves, and throw light from new investigations upon subjects hitherto untouched.

"Those who have followed Mr. Beebe's remarkable investigations in the Zoological Park will appreciate what it means to place him, with a corps of enthusiastic assistants, at the edge of a great tropical wilderness teeming with bird life, provided with all necessary facilities, and favoured by the Government of British Guiana. There, if anywhere on earth, may we expect new light on the evolution of birds, and the life histories of strange species.

"Take, for example, the hoatzin, with its strong presumption of tree climbing ancestors. Up to date, not one living of tree climbing ancestors. Up to date, not one living hoatzin, old or young, ever has reached a zoological park, or been studied alive in captivity. Mr. Beebe's laboratory will be within easy reach of an indefinite number of living and breeding 'hoatzins Soon we will know more of this strange species; and it requires no strain upon the prophetic instinct to predict moving pictures of hoatzins at home.

"The second object of the laboratory and its staff will be the gathering of mammals, birds, reptiles, amphibians, and insects for the zoological park, and fishes for the Aquarium. To this end Mr. Donald Carter will be taken from the Zoological Park Force as Collector. In view of the great difficulty that always has attended the procuring in good health of mammals and birds from South America, the collecting function of the Laboratory will, by some persons, be regarded as its most important work. While we also have great expectations from that line of endeavour, and very much need the accessions, we feel that the scientific work to be done is of paramount importance.

"Mr. Beebe has been fortunate in enlisting, as Research Associate, the interest of the self-sacrificing services of Mr. G. Inness Hartley, an ardent student of avian life who has generously volunteered to devote his entire time to research work with the Zoological Society.

"Mr. Paul G. Howes, an expert in micro-photography and the intensive study of invertebrates will take a place in the tropical Laboratory as Research Assistant.

"The Government of British Guiana has generously offered the use of facilities in the Botanic Gardens, besides the privilege of importing apparatus and supplies free of duty.

"The Trinidad Steamship Company has joined in promoting the whole enterprise by providing for the transportation of collections on most liberal terms, and co-operating in many matters of importance to the success of the enterprise.

"Finally, five members of the Board of Managers of the Zoological Society have subscribed, on a basis of $1,000 each, the entire sum necessary for the work of the Laboratory, during its first year. These gentlemen are Cleveland H. Dodge, Mortimer L. Schiff, C. Ledyard Blair, James J. Hill and George J. Gould.

"The element of novelty attaching to the Society's new scientific enterprise will focus upon it the attention of American zoologists. Already there are signs that a number of investigators will seek the hospitality that our tropical station will afford, and not the least of the pleasure and benefit to be derived from the station by our Society will be the satisfaction that can be found in promoting the work of zoological investigators who never yet have enjoyed such an opportunity for getting close to animate tropical nature as this station will afford."

A pleasing feature has been the inclusion in Dr. Beebe's party of two ladies—Miss Taylor and Miss Hartley—who, we understand, are to devote themselves more especially to the artistic recording of the results of the work, and who have already taken to the life involved with an enthusiasm and confidence which are infinitely refreshing. We extend a hearty welcome to Dr. Beebe and his party and offer our best wishes for their success: we applaud the wisdom which chose British Guiana as the site of the staion: but we must confess to a feeling of regret that so interesting a work in a British colony, and one so promising of valuable results (in the best sense of the term) should have been left to the enterprise of citizens of the United States.

Areas Under Experimental Cultivation, 1914 and 1915.

The areas under experimental cultivation at the different stations of the Department during the years were as follows:—

Products.	Acreage.	Products.	Acreage.
Rubber, Para	99	Balata	6
„ Sapium ..	2	Fruit Trees ..	4½
„ Other Sorts ..	1	African Oil Palm ..	3
Limes	32	Castor Oil	1½
Coconuts	30	Tonka Beans ..	1½
Coffee	23	Bananas	1
Sugar Canes	20	Cotton, Sisal Hemp, Ginger Lilies, Carludovica, Palms, &c.	1
Cacao	19		
Rice	7	Ground Provisions (various) ..	5-10

Ducks as a Preventive of Malaria and Yellow Fever.

Ducks, which occur in all regions of the globe, are among the greatest enemies of mosquitoes, and consequently of yellow fever and malaria. Their value in this respect has been determined as follows: By means of dams two pools of equal area were made in a stream. Ducks were placed in one and fish in the other. The former was speedily cleared of mosquitoes, while the second continued to maintain the insects in all stages of development. Wild ducks were then introduced and found to prefer the insects to all other foods. At the end of twenty-four hours no pupæ were found in the pond and after two days all the larvæ had been destroyed. These experiments confirm the observations of William Lockwood, who found that the duck was particularly adapted to devouring the larvæ on the surface of water, and of McAtee, who found mosquitoes in the gizzard of a wild duck.

The mosquito has numerous animal enemies, of which the duck is the most widespread and consequently the most suitable to clean up unhealthy marshy districts which it would be too costly to drain.

—"The Colonial Journal," October, 1915.

Sugar Cane on the Experimental Fields. Crops of 1914.

(By Professor J. B. Harrison, C.M.G., M.A., Director; C. K. Bancroft, M.A., F.L.S., Assistant Director; and R. Ward, Agricultural Superintendent.)

The sugar cane experiments were carried on at the experimental Fields under the direct supervision of the Agricultural Superintendent.

SEEDLINGS.

The work in connection with the raising of seedlings of sugar cane was continued. In all 9,730 seedlings were raised. Of these 3,510 have been retained at the Botanic Gardens and 1,517 distributed to sugar estates in the colony. Of the seedlings retained at the Botanic Gardens 1,486 were possible crosses; while 315 were selfs.

The more important varieties crossed were:—

D 118 x D 419	Bourbon x D 419
D 118 x Red Ribbon	D 4399 x Red Ribbon
D 118 x D 4399	D 419 x Red Ribbon
D 118 x Java 139	D 419 x D 4399
D 625 x Red Ribbon	D 74 x D 118

68,860 cuttings of sugar cane were also distributed to estates during the year, the principal varieties being:—

Seedling Canes.	*Number of Cuttings Distributed.*
D 625	5,180
D 118	9,720
D 419	7,300
D 721	10,100
D 167	7,560
D 4399	1,500
D 317	7,280

RAINFALL.

The rainfall at the Botanic Gardens from January 1st to December 31st was 69.49 inches, 21.72 inches less than the average for the past thirty-three years. Of that 18.37 inches fell in May alone. The precipitation was, however, not unevenly distributed over the rest of the year and

apart from the customary dry spell from September to November the weather was more favourable to growth of sugar canes than a casual observation of the total amount of rainfall would indicate.

The crops on the Experimental Fields were reaped in December, 1914. The returns were not satisfactory, due in part to the defective rainfall but more largely to the long period the various fields have been under sugar cane cultivation without any rest.

The South field was not under cultivation during the year as it was considered absolutely necessary to let it fallow from sugar cane under which it had been in practically continuous cultivation for twenty-two years.

RESULTS FROM VARIETIES.

The varieties grown on the North-east field which has been under continuous cultivation for thirteen years gave the following mean results:—

Varieties.	*Cane per acre.* *Tons.*	*Saccharose in expressed juice.* *Tons.*
D 721	21.3	2.14
D 118	19.7	2.04
D 317	19.9	1.93
D 167	18.4	1.91
D 625	16.2	1.55
D 419	13.9	1.46
D 454	12.4	1.16

The average characteristics of the expressed juices of the above varieties were:—

TABLE I.

Variety.	*Specific Gravity* $\frac{30^\circ}{16.6^\circ}$	*Pounds per Gallon.* *Sucrose*	*Glucose*	*Solids not Sugar.*	*Quotient of Purity.*	*Glucose Ratio.*	*Non. Sugar Ratio.*
D 419	1.0795	1.843	.045	.273	85.3	2.44	14.8
D 118	1.0767	1.745	.055	.286	83.6	3.15	16.4
D 167	1.074	1.676	.059	.281	83.1	3.52	16.7
D 317	1.0717	1.646	.052	.258	84.1	3.16	15.5
D 721	1.070	1.624	.085	.202	84.4	5.23	12.4
D 454	1.070	1.594	.071	.252	83.1	4.45	15.8
D 625	1.0707	1.568	.107	.263	80.9	6.82	16.8

RESULTS OF MANURES.

The trials with sulphate of ammonia and nitrate of soda and with applications of increasing quantities of nitrogen were confined to the North East field. The mean results were:—

Treatment..	*Canes per acre.*	*Saccharose in expressed juice.*
	Tons.	*Tons.*
No Nitrogen	12.5 ..	1.24
150lb. Sulphate of Ammonia ..	18.5 ..	1.83
300lb. ,, ,, ..	20.9 ..	2.09
450lb. ,, ,, ..	23.5 ..	2.34
No Nitrogen	12.0 ..	1.22 ..
300lb Sulphate of Ammonia ..	21.1 ..	2.16
375lb. Nitrate of Soda ..	17.9 ..	1.82

The mean results on land not manured and manured with phosphates were as follows:—

			Tons Canes per Acre.
30 plots,	No phosphates	..	.. 19.5
,, ,,	Superphosphate	..	.. 20.0
12 plots,	No phosphates	..	.. 18.7
,, ,,	Superphosphate	..	.. 19.3
,, ,,	Slag phosphate	..	.. 19.7

The results with the nitrogenous and phosphatic manures were concordant with those of previous years.

Every plot in the North-west field received sulphate of ammonia at the rate of 300 lbs. per acre. This was done with the object of testing the yields of the individual plots as well as of the varieties as a final check on the results of the four crops during which trials with various forms of nitrogenous manures were in progress on them. The results showed that the errors introduced by plot variations were far less than the differences apparently due to the manurings.

The mean results of the varieties were:—

Variety.	*Tons Canes per acre.*	*Tons Saccharose in juice per acre.*
419 ..	.. 31.9 ..	.. 3.34
118 ..	.. 26.6 ..	.. 3.11
625 ..	.. 29.6 ..	.. 2.86

Variety.	*Tons Canes per acre.*	*Tons Saccharose in juice per acre.*
167	28.5	2.68
721	29.0	2.66
333	22.2	2.44
638	23.9	2.32
317	23.6	2.30
44	24.7	2.28
139	24.2	2.21
246	20.6	2.15
642	23.5	2.15
4399	20.7	2.12
154	22.4	2.10
454	15.7	1.45
631	14.6	1.42

The characteristics of their expressed juices are shown in the following:—

TABLE II.

Variety.	*Specific Gravity* $\frac{30^\circ}{16.6^\circ}$	*Pounds per Gallon.*			*Quotient of Purity.*	*Glucose Ratio.*	*Non-Sugar Ratio.*
		Sucrose	*Glucose.*	*Solids not Sugar.*			
D 118	1.0805	1.889	.045	.253	86.4	2.38	13.4
D 333	1.0745	1.729	.063	.238	85.1	3.64	13.7
D 246	1.0735	1.700	.040	.260	85.0	2.35	15.3
D 419	1.0725	1.676	.065	.232	84.9	3.88	15.0
D 651	1.0715	1.671	.053	.226	85.7	3.17	13.5
D 317	1.0717	1.646	.052	.228	84.2	3.16	13.8
D 167	1.071	1.622	.044	.272	83.7	2.71	16.7
D 455	1.070	1.603	.071	.235	83.9	4.43	14.6
D 154	1.0685	1.595	.044	.243	85.3	2.85	15.2
D 4399	1.071	1.595	.081	.294	82.3	5.08	18.4
D 638	1.0685	1.587	.079	.206	84.7	4.97	12.9
D 721	1.0715	1.561	.116	.273	80.0	7.43	17.5
D 625	1.0702	1.553	.122	.240	81.1	7.86	15.4
D 44	1.070	1.544	.139	.227	80.5	9.00	14.7
D 139	1.067	1.502	.021	.310	82.0	1.39	20.6
D 642	1.0645	1.475	.039	.254	83.4	2.78	17.2

The yields of sugar-cane calculated to tons per acre on the areas in the northern division of the field were:—

Plots.	Series 1	21.75
	" 2	23.2
	" 3	22.3
	" 4	22.5
	" 5	21.95
	" 6	20.3
	" 7	20.7
	" 8	22.05
	" 9	21.0

The mean yield of the nine series was 21.7 tons per acre, that of the four series which had been used as not manured controls being 22 tons and that of the five series which had been manured with nitrogenous manure being 21.35 tons

The probable errors due to soil differences in the manured and not manured series were ± 1.8% and ± 1.1% respectively, equal to .4 and .25 tons of canes per acre.

The yields of sugar-cane calculated to tons per acre on the areas in the southern division of the field were:—

Plots.	Series 1	19.8
	" 2	19.05
	" 3	19.7
	" 4	21.0
	" 5	21.0
	" 6	21.8
	" 7	21.2
	" 8	21.55

The mean yield of the eight series was 20.6 tons per acre, that of the three series which had been used as not manured controls being 20.6 tons, whilst that of the five series which had been manured with nitrogenous manures was the same.

The probable errors due to soil differences in the manured and not manured series were ± 1.45% and ± 2.9%, respectively, equal to .3 and .6 ton of canes per acre.

The probable single plot errors in the two series of comparisons with nitrogenous manures were ± 2.7% and ± 2.5% on the northern plots and ± 5.2% and ± 3.35% on the southern plots That is the yields per acre on

single plots probably might have been affected by soil difference to the extent of 1.1 ton of canes.

The mean yields during the four crops 1910-1913 presumably due to 60 lbs. of nitrogen in each of the manure applications were:—

	Tons of Canes per Acre.
Sulphate of Ammonia	9.4 ± 1.5
Nitrate of Lime	6.7 ± 1.3
Nitrolim	5.8 ± 1.3
Nitrate of Soda	3.1 ± 1.1

The subject of the gains or losses per acre caused by manurings and croppings among the more important soil-constituents called for attention during the year in connection with the fact that the demands of D 625 on these are higher than are those of the Bourbon in the production of equal weights of sugar per acre.

COMPOSITION OF THE SOIL.

In our earlier investigations into the question of gains and losses of soil constituents we had examined samples of soils drawn, in the majority of cases, from at least 9 similarly manured and treated plots although in a few cases only not more than 4 plots were available.

The soil of the north-eastern field was sampled in 1901 prior to the commencement of the varietal and manuring experiments which have since been carried on for 11 crops. The samples were carefully drawn from the north and south sections of 24 plots which have been used as not-manured control plots. The 48 samples were mixed together and the composite sample analysed. The composite sample yielded:—

Nitrogen	.170 per cent.
Soluble in 1% citric acid solution	
Calcium oxide	.087 " "
Potassium oxide	.015 " "
Phosphoric anhydride ..	.008 " "

From 1901 to 1914 two series each of six double plots on the field have been under continuous cultivation with D 625, the series being Plots Nos. 13 to 18 and Nos. 61 to 66. The northern section of each plot was dressed yearly with phosphatic manures, whilst the southern section was not so manured. Two plots on each series did not receive

any nitrogenous manure whilst the others received manurings of sulphate of ammonia in increasing proportions at rates of 100 lbs, 200, 300 and 400 lbs. per acre.

Samples of the soils of each half plot were very carefully taken so as to be fairly representative of the soil of that plot. Each of these 24 samples was examined separately, making a mechanical analysis, determination of the "humus," of total nitrogen, and of the nitrogen in the humus, and estimation of the calcium oxide (lime), potassium oxide (potash) and phosphoric anhydride soluble in one per cent. citric acid solution under conditions of constant shaking for 6 hours in a very effectual shaking machine.

As checks on the accuracy of the chemical determination seven average samples were prepared by mixing equal proportions of each of

(a) the eight samples drawn from non-manured plots:

(b) the eight samples drawn from plots receiving either 100 or 200 lbs. of sulphate of ammonia per acre;

(c) the eight samples drawn from plots receiving either 300 or 400 lbs. of sulphate of ammonia per acre.;

(d) the six samples from the northern sections of plots 13 to 18;

(e) the six samples from the southern sections of plots 13 to 18;

(f) the six samples from the northern sections of plots 61 to 66;

(g) the six samples from the southern sections of plots 61 to 66;

In each of the seven composite samples thus prepared the total nitrogen was determined, whilst in the four composite samples (d), (e), (f), and (g) the proportion of calcium oxide, potassium oxide and phosphoric anhydride soluble in 1% citric acid solution were also estimated. The soil does not contain any lime in the form of calcium carbonate and the calcium oxide dissolved by the citric acid solution must be derived from calcium phosphate, calcium silicate or the traces of calcium sulphate present in the soil.

The following tables give the results of the mechanical analyses of the samples of the dry soil:—

TABLE III.

Western Section of Field.

Plots 13 to 18.

Plots Running from South to North.

	Coarse Sand.	*Fine Sand.*	*Coarse Silt.*	*Fine Silt.*	*Clay.*	*Loss on Ignition.*
Plot 13 S	7.7	5.2	6.4	3.9	64.4	12.4
N	7.7	6.4	4.8	6.0	64.9	10.2
Plot 14 S ...	6.3	9.2	7.7	7.2	59.0	10.6
N... ...	8.6	6.4	6.5	5.0	62.5	11.0
Plot 15 S	8.2	7.9	8.2	4.0	59.1	12.6
N... ..	12.5	7.9	5.8	5.1	57.8	10.9
Plot 16 S	11.3	6.2	6.7	5.8	57.6	12.4
N... .	11.9	6.6	6.9	5.4	57.2	12.0
Plot 17 S	12.0	6.3	7.7	5.4	57.7	10.9
N... ..	8.5	4.5	7.3	3.9	63.3	12.5
Plot 18 S	8.0	4.4	7.4	4.0	65.4	10.8
N. . .	7.8	5.9	5.2	5.5	64.7	10.9
Means 13–18 .	9.2	6.4	6.7	5.1	61.2	11.4

TABLE IV.

Eastern Section of Field

Plots 61 to 66.

Plots Running from South to North.

	Coarse Sand.	*Fine Sand.*	*Coarse Silt.*	*Fine Silt.*	*Clay.*	*Loss on Ignition.*
Plot 61 S	9.6	4.6	8.0	4.1	62.4	11.3
N... ...	10.3	6.8	6.5	5.8	58.9	11.7
Plot 62 S . .	10.2	5.7	3.8	5.9	62.9	11.5
N... ...	8.4	5.2	7.0	5.1	63.2	11.1
Plot 63 S	8.3	8.9	7.8	4.0	58.8	12.2
N... ...	10.9	6.7	6.5	4.7	58.3	12.9
Plot 64 S ...	8.6	5.7	6.2	4.6	62.7	12.2
N... ...	8.7	6.5	8.0	6.6	57.3	12.9
Plot 65 S	9.2	6.9	8.1	6.4	57.4	12.0
N... ..	9.0	8.3	9.8	4.2	55.7	13.0
Plot 66 S	5.9	6.0	7.7	3.5	64.6	12.3
N... ...	9.8	6.8	7.7	5.6	57.5	12.6
Means 61–66 ...	9.1	6.5	7.2	5.0	60.1	12.1

From these data the soil has the following average mechanical composition:—

Coarse Sand...	9.15	±	.25
Fine Sand ...	6.45	±	.17
Coarse Silt ...	6.95	±	.17
Fine Silt ...	5.05	±	.14
Clay ...	60.65	±	.52
Loss on Ignition ...	11.75	±	.14
	100.00		

The "probable errors" in excess or deficit of the analyses of single samples were as follows:—

	Per cent. On Soil.	Per cent. On Constituents.
Coarse Sand ..	1.4	15.3
Fine Sand ..	.80	12.4
Coarse Silt ..	.85	12.2
Fine Silt ..	.68	13.4
Clay ..	2.46	4.0
Loss on Ignition ..	.68	5.8

To reduce the probable errors within reasonable limits, say of one half of one per cent. for each constituent other than clay, on which being determined by difference the accumulated errors fall, and for this purpose to obtain a reliable sample of the soil of a five acre absolutely flat, apparently uniform field, the sample must be drawn from at least 9 different plots scattered over the field and preferably from 16 From each plot the sample must be drawn —as the samples were in the present investigation—from at least five places and a sample representative of the soil of the plot prepared by mixing them together.

The proportion of "Loss on Ignition," "Humus" (organic matter soluble in dilute (2%) sodium hydrate solution after washing the soil with very dilute hydrochloric acid) Nitrogen in "humus" and Total Nitrogen on the various plots grouped according to their manurial treatments are given in the following tables:—

TABLE V.

No Nitrogen Plots.

Plots.	*Loss on Ignition.*	*Humus.*	*Nitrogen in Humus.*	*Total Nitrogen.*
14 S	10.58	1.20	.0355	.1986
N	10.94	1.09	.0365	.1769
18 S	10.85	1.22	.0410	.1787
N	10.94	1.05	.0319	.1632
61 S	11.28	1.58	.0363	.1777
N	11.68	1.58	.0362	.1700
64 S	12.28	1.14	.0255	.1681
N	12.99	1.55	.0297	.1916
Means	11.44	1.30	.0341	.1781
	±.26	±.08	±.0015	±.0042
Composite Sample, Plots 14, 18, 61 & 64				.1777

Low Nitrogen Plots.

Plots.	*Loss on Ignition.*	*Humus.*	*Nitrogen in Humus.*	*Total Nitrogen.*
16 S	12.39	1.61	.0401	1588
N	12.14	1.17	.0415	1769
17 S	10.79	1.10	.0333	.1629
N	12.56	1.40	.0403	.1742
62 S	11.51	1.50	.0321	.1925
N	11.17	1.40	.0354	.1796
66 S	12.26	1.18	.0332	.1606
N	12.59	1.38	.0298	.1707
Means	11.92	1.38	.0357	.1720
	±.23	±.05	±.0014	±.0030
Composite Sample, Plots 16, 17, 62 & 66				.1731

High Nitrogen.

Plots.	Loss on Ignition.	Humus.	Nitrogen in Humus.	Total Nitrogen.
13 S	12.49	.95	.0365	.1862
N	10.25	1.09	.0339	.1655
15 S	12.57	1.28	.0372	.1750
N	10.87	1.10	.0377	.1805
63 S	12.29	1 38	.0359	.1742
N	12 94	1.45	.0329	.1764
65 S	12.62	1 17	.0255	.1533
N	12 28	1.17	.0297	.2028
Means	12.04	1 20	.0337	.1767
	±.29	±.05	±.0013	±.0041
Composite Sample, Plots 13, 15, 63 & 65				.1766

It is evident that the distribution of the nitrogen is very irregular among the plots varying in the three series to the following extents:—

	Nitrogen in humus.			*Total Nitrogen.*		
	Mean.	*Maximum.*	*Minimum.*	*Mean.*	*Maximum.*	*Minimum.*
No Nitrogen ...	.0341	.0255	.0410	.1781	.1632	.1986
Low Nitrogen...	.0357	.0298	.0415	.1720	.1588	.1925
High Nitrogen	.0337	.0255	.0377	.1767	.1533	.2028

The mean content of nitrogen determined on the 24 samples was .1756 per cent., on the three composite samples, .1758, while on the composite of 48 samples in 1901 it was .170.

From these results a sample must be taken from at least eight plots in order to obtain reliable results on either the nitrogen, the humus or the total nitrogen.

The data obtained by the determination of the calcium oxide, potassium oxide and phosphoric anhydride soluble in one per cent. citric acid solution in the soils from the sec-

tions of the plots which were not manured with phosphates are given in the following:—

TABLE VI.

Plots South Sections.	*Percentage of*		
	Calcium Oxide.	*Potassium Oxide.*	*Phosphoric Anhydride.*
13	.0808	0117	.0099
14	.0869	.0148	.0111
15	.0625	.0136	.0077
16	.0813	0115	.0084
17	.0571	.0137	.0066
18	.0426	.0113	.0053
61	.0444	.0097	.0079
62	.0601	.0124	0077
63	.0419	.0107	0049
64	.0553	0152	.0068
65	.0636	.0135	0050
66	.0636	.0167	.0054
Plots 13 to 18.			
Means	.0685	.0127	.0082
	.0076	.0007	.0008
Composite Sample...	.0606	.0145	.0087
Plots 61 to 66.			
Means . ..	.0548	.0130	.0063
	.0041	0011	.0006
Composite Sample...	.0591	.0114	0079

Plots North Sections.	Percentage Calcium Oxide.	Potassium Oxide.	Phosphoric Anhydride.
13	.0860	.0107	.0102
14	.0627	.0149	.0119
15	.0719	.0148	.0125
16	.0597	.0115	.0069
17	.0446	.0100	.0079
18 .	.0660	.0144	.0097
61	.0707	.0169	.0092
62	.0399	.0183	.0086
63	.0661	.0115	.0093
64	0520	.0163	.0059
65	.0693	.0155	.0056
66 ..	0603	.0187	.0052
Plots 13 to 18 Means	.0660	.0144	.0097
	± 0054	±.0011	±.0009
Composite Sample...	.0747	0096	0083
Plots 61 to 66 Means .	.0597	.0162	.0074
	±.0049	±.0008	±.0009
Compos'te Sample...	0602	.0171	.0084

From these tables and the records of the total nitrogen given in table No. V. the following average results are obtained :—

	Nitrogen.	*Calcium Oxide.*	*Potassium Oxide.*	*Phosphoric Anhydride.*
South Sections without phosphates	.1739 ±.0032	.0616 ±.0041	.0129 ±.0006	.0072 ±.0005
North Sections with phosphates	1773 ±.0022	.0628 ±.0044	.0153 ±.0007	.0085 ±.0006

The mean results of the corresponding composite samples were :—

	Nitrogen.	*Calcium Oxide.*	*Potassium Oxide.*	*Phosphoric Anhydride.*
South Sections without phosphates	.1749	.0599	.0130	.0073
North Sections with phosphates	.1769	.0674	.0134	.0083

It is evident that to obtain fairly reliable results with regard to so-called "available" calcium oxide, potassium oxide and phosphoric anhydride, samples of soil must be drawn from at least 6 similarly treated plots.

By determining the apparent specific gravity of the soil it was found that its weight over an acre to a depth of 8 inches is 2,350,000 lbs., and that therefore .001 per cent. of any constituent in it is equal to 23.5 lbs. of that constituent per acre. In the following the weights in lbs. per acre of the "humus," the nitrogen in the humus, total nitrogen and of calcium oxide, potassium oxide and phosphoric anhydride soluble in 1% citric acid are shown:—

TABLE VII.

Plots.	*Humus.*	*Nitrogen in humus*	*Total Nitrogen.*	*Soluble in 1% Citric Acid Solution.*		
				Calcium Oxide.	*Potassium oxide*	*Phosphoric anhydride.*
13 S ...	22,400	858	4,375	1,900	275	232
13 N ..	25,445	796	3,889	1,981	251	240
14 S	28,320	834	4,667	2,043	348	261
14 N	25,732	857	4,157	1,473	350	279
15 S .	30,000	874	4,113	1,469	320	181
15 N .	25,920	886	4,242	1,689	348	294
16 S	37,950	942	3,732	1,911	270	197
16 N ...	27,589	975	4,157	1,666	343	209
17 S	25,920	782	3,828	1,340	322	155
17 N	32,950	947	4,094	1,403	270	162
18 S ...	28,700	963	4,200	1,001	266	124
18 N ...	24,630	749	3,835	1,048	235	186
61 S ...	37,230	853	4,176	1,043	185	186
61 N ...	37,230	851	3,995	1,661	397	216
62 S ...	35,180	754	4.524	1,413	291	181
62 N ...	32,950	832	4,221	937	375	202
63 S ...	32,410	844	4,094	985	251	115
63 N ...	34,070	773	4,145	1,553	270	219
64 S ...	26,840	599	3,950	1,300	357	160
64 N ...	36,470	848	4,503	1,222	383	129
65 S ...	27,590	599	3,603	1,495	317	117
65 N ...	27,400	698	4,767	1,628	364	132
66 S ...	27,780	780	3,774	1,495	392	201
66 N ...	32,410	700	4,011	1,417	439	61
Means ...	30,193	813	4,127	1,469	326	185
Average of the Composite Samples ...	Not determined		4,123	1,495	310	183

The manurial treatment and average yield of produce per crop during twelve crops on each of the plots were as follows:—

Number and Treatments of Plots.	*South Section. No Phosphates.*	*North Section. Phosphates.*
No nitrogenous manure—		
14	31.7	31.3
18	29.1	30.5
64	40.1	40.4
Low nitrogen: (130 lbs. ammonium sulphate)—		
17	29.0	30.8
61	33.6	37.9
66	42.9	45.3
62	35.4	38.5
Medium nitrogen: (252 lbs. ammonium sulphate)—		
16	39.0	43.4
High nitrogen: (350 lbs. ammonium sulphate)—		
15	44.3	43.9
63	48.7	47.8
13	42.8	43.2
65	46.0	47.1

The average yields having been determined on each of the fields during 12 crops it is of interest to contrast the yields of plots similarly manured but having different percentages of nitrogen, thus:—

	Nitrogen.		*Yield, 12 Crops in tons of Produce.*
	Per Cent.	*Pounds per Acre.*	
13 N	.1655	3,889	518.4
65 N	.2028	4,767	565,2
13 S	.1862	4,375	531.3
65 S	.1533	3,603	552.0
18 S	.1787	4,200	349.2
14 S	.1986	4,667	380.4
61 N	.1700	3,995	454.8
64 N	.1916	4,503	469.2

In the following comparisons the nitrogen content of the plots was approximately similar:—

	Nitrogen.		*Yield, 12 Crops in tons of Produce.*
	Per Cent.	*Pounds per Acre.*	
17 N	.1742	4,094	369.6
66 N	.1707	4,011	543.6
17 S	.1629	3,828	348 0
66 S	.1606	3,774	514.8
15 S	.1750	4,113	531.6
63 S	.1742	4,094	571.2

It is clear that the differences in the yields were not governed by the differences in the total nitrogen of the soil.

Similar comparison with the nitrogen in the humus results as follows:—

	Nitrogen.		*Yield, 12 Crops in tons of Produce.*
	Per Cent.	*Pounds per Acre.*	
13 N	.0339	796	518.4
65 N	.0297	698	565.2
13 S	.0365	858	513.6
65 S	.0255	599	552.0

while in the following the proportion of the nitrogen in the humus is approximately similar:—

	Nitrogen.		*Yield, 12 Crops in tons of Produce.*
	Per Cent.	*Pounds per Acre.*	
15 S	.0372	874	531.6
63 S	.0359	844	571.2
17 S	.0333	982	348.0
66 S	.0332	780	514.8

Thus the "humus" portion of the organic matter does not appear to influence the yield: it is inert.

Although the varying quantities of nitrogen in the soil and in the humus of the soil apparently in no way governed the yield of the plots, these can be clearly shown to be due to the proportions of available nitrogen present therein or rather added during the active growth of the crops:—

Plots.	Nitrogen added in Manure : 12 Crops lbs.	Mean Returns. 12 Crops Tons.	Mean Returns. Due to added Nitrogen · Tons.
14, 18 & 64 ...	nil	402.6	
17, 61, 66 & 62 ..	327	439.8	37.2
16	636	494.4	91.8
15, 63, 13 & 65 . ..	882	545.6	143.0

That is additions of nitrogen in manure equal to 27.3, 53 and 73.5 lbs. or to that supplied by 130, 252 and 350 lbs. of sulphate of ammonia per crop resulted in gains of 3.1, 7.7 and 11.9 tons of produce respectively. These annual additions of nitrogen are practically negligible in amount when compared with the differences in the content of nitrogen of the similarly treated plots.

It is not possible to trace any relationship in the yields of the plots to their relative contents of either so called available calcium oxide, potassium oxide or phosphoric anhydride; but as our long continued field trials have shown that soils containing more than .005 per cent. of either potassium oxide or phosphoric anhydride soluble in one per cent. citric acid solution do not respond to manurings with these substances the results are thus consistent with experience.

Although these negative results with regard to potassium oxide and phosphoric anhydride are concordant with our earlier experience on the heavy clay soil and under the conditions of high rainfall prevalent in Demerara, that experience may not hold good for the proportion of these constituents present in lighter sugar-cane soils where the rainfall is lower. It is possible that in Berbice and probably on many sugar-cane soils in Barbados and other West Indian islands of comparatively low rainfall that the

limits at which dressings of potash and phosphates cease to exert beneficial influence are higher than on the Demerara soils. In them it is probable that phosphoric acid and especially potash will act beneficially on the yields of the sugar-cane on lands the soil of which contains more than .005 per cent. of each of these constituents.

HYBRIDISATION EXPERIMENTS.

Many examinations were made of new varieties of sugar-cane raised from seed in 1912 and earlier years. For the first time it was possible to compare the saccharose content of a considerable number of hybrid varieties with that of their parent canes. In former years we had not a sufficient number of hybrids of different derivations for making satisfactory comparison, but the indications were that in accordance with proved facts of plant breeding the result of crossing varieties of mixed parentage was to increase the variation in the progeny not to decrease it—in other words, to add to the complexity of the problem instead of reducing it. If we had canes of pure parentage of durable properties the problem would be a relatively simple one but we have not—all the varieties we have of approximately pure parentage are small weedy canes of low saccharose content quite unsuitable as sugar producers with the climatic conditions of British Guiana.

The following shows the parentage and the number examined of hybrid or controlled parentage canes:—

Crosses.	*No. of Plants.*
118 x 625	4
118 x 167	5
118 x 504	4
118 x 145	19
118 x 95	17
625 x 95	4
419 x 95	47
145 x 95	8
4395 x 95	2
419 x 145	7
145 x	2
95 x Red Ribbon	1
625 x Red Ribbon	7
73 x Red Ribbon	9

Table No. VIII. shows the results of the more important hybridisation trials:—

TABLE VIII.

	Parents.				Seedlings, Ordinary.				Seedlings, hybrids	
	Maximum.	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*
			Hybrids of 118 x 625							
	118		625		118		625		118 x 625	
Average Weight of one Cane in lbs.	5.0	3.5	5.9	4.2	12.0	4.3	11.8	3.5	6.3	4.0
Juice, Specific Gravity $\frac{30^{\circ}}{15.5}$ ...	1081	1076	1074	1070	1082	1048	1082	1048	1072	1056
,, Sucrose, lbs. per gallon ...	1.910	1.733	1.608	1.561	1.978	1.296	1.868	.994	1.718	1.276
,, Glucose, lbs. per gallon ...	.059	.041	.131	.086	.227	.020	.196	.023	.071	.048
			Hybrids of 118 x 167							
	118		167		118		167		118 x 167	
Average Weight of one Cane in lbs.	5.0	3.5	5.5	4.4	12.0	4.3	Nil	Nil	5.6	4.3
Juice, Specific Gravity $\frac{30^{\circ}}{15.5}$ ...	1081	1076	1074	1068	1082	1048			1073	1058
,, Sucrose, lbs. per gallon ...	1.910	1.733	1.702	1.541	1.978	1.296			1.728	1.213
,, Glucose, lbs. per gallon .	.059	·041	.061	.042	.227	.020			.113	.041
			Hybrids of 118 x 504							
	118		504		118		504		118 x 145	
Average Weight of one Cane in lbs.	5.0	3.5	4.7	3.8	12.0	4.3	6.6	3.0	7.3	3.6
Juice, Specific Gravity $\frac{30^{\circ}}{15.5}$ ...	1081	1076	1076	1070	1082	1048	1078	1052	1081	1057
,, Sucrose, lbs. per gallon .	1 910	1.733	1.719	1.480	1.978	1.296	1.764	1.114	1.910	1.198
,, Glucose, lbs. per gallon ...	.059	.041	.026	.022	.227	.020	.080	.029	.169	.033

TABLE VIII.—Continued.

	Parents.				*Seedlings, Ordinary.*				*Seedlings, hybrids*	
	Maximum.	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*
			Hybrids of 118 x 145							
	118		145		118		145		118 x 145	
Average Weight of one Cane in lbs.	5.0	3.5	5.2	4.7	12.0	4.3	9.6	3.0	9.7	4.0
Juice, Specific Gravity $\frac{30°}{16.6}$ ...	1081	1076	1082	1080	1082	1048	1084	1052	1079	1068
,, Sucrose, lbs. per gallon ...	1.910	1.733	1.988	1.889	1.978	1.296	2.066	1.052	1.660	1.634
,, Glucose, lbs. per gallon ...	.059	.041	.156	.122	.227	020	.158	.019	.073	.066
			Hybrids of 118 x 95							
	118		95		118		95		118 x 95	
Average Weight of one Cane in lbs.	5.0	3.5	2.5	2.0	12.0	4.3	Nil	Nil	10.0	3.7
Juice, Specific Gravity $\frac{30°}{16.6}$ ...	1081	1076	1090	1088	1082	1048			1084	1068
,, Sucrose, lbs. per gallon ...	1.910	1.733	2.177	2.050	1.978	1.296			2.099	1.473
,, Glucose, lbs. per gallon ...	.059	.041	.042	.03[illegible]	.227	.020			.166	.086
			Hybrids of 625 x 95							
	625		95		625		95		625 x 95	
Average Weight of one Cane in lbs.	5.9	4.2	2.5	2.0	11.8	3.5	Nil	Nil	4.0	4.0
Juice, Specific Gravity $\frac{30°}{16.6}$ ...	1074	1070	1090	1088	1082	1048			1072	1071
,, Sucrose, lbs. per gallon ...	1.608	1.561	2.177	2.050	1.863	994			1.723	1.681
,, Glucose, lbs. per gallon ...	.131	.086	.042	.036	196	023			.066	.016

TABLE VIII.—Continued.

	Parents.				*Seedlings, Ordinary.*				*Seedlings, hybrids*	
	Maximum.	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*
	Hybrids of 419 x 95									
	419		95		419		95		419 x 95	
Average Weight of one Cane in lbs	6.8	4.4	2.5	2.0	9.0	4.6	Nil	Nil	6.5	3.2
Juice, Specific Gravity $\frac{30^\circ}{15.6}$ . .	1081	1071	1090	1088	1083	1060			1084	1066
,, Sucrose, lbs. per gallon ..	1.884	1.624	2.177	2.050	2.035	1.255			2.076	1.484
,, Glucose, lbs. per gallon .	.069	.045	.042	.030	.227	.051			.151	.071
	Hybrids of 145 x 95									
	145		95		145		95		145 x 95	
Average Weight of one Cane in lbs.	5.2	4.7	2.5	2.0	9.6	3.0	Nil	Nil	8.5	5.7
Juice, Specific Gravity $\frac{30^\circ}{15.6}$ ...	1082	1080	1090	1088	1084	1052			1076	1067
,, Sucrose, lbs per gallon .	1 988	1.889	2 177	2.050	2.066	1.052			1.915	1.499
,, Glucose, lbs per gallon ...	.156	.122	.042	.030	158	.019			.279	.073
	Hybrids of 4395 x 95									
	4395		95		4395		95		4395 x 95	
Average Weight of one Cane in lbs.	4.0	3.7	2.5	2.0	16.7	3.5	Nil	Nil	6.2	5.2
Juice, Specific Gravity $\frac{30^\circ}{15.6}$ ...	1067	1063	1090	1088	1076	1052			1068	1059
,, Sucrose, lbs. per gallon ...	1.401	1.328	2.177	2.050	1 790	1.094			1.589	1.302
,, Glucose, lbs. per gallon . .	.050	.046	.042	.030	.149	.022			.166	.100

TABLE VIII.—Continued.

	Parents.				*Seedlings, Ordinary.*				*Seedlings, hybrids*	
	Maximum.	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*
			Hybrids of 419 x 145							
	419		145		419		145		419 x 145	
Average Weight of one Cane in lbs.	6.8	4.4	5.2	4.7	7.6	4.6	9.6	3.0	3.7	3.2
Juice, Specific Gravity $\frac{30^\circ}{15.5}$.	1081	1071	1082	1080	1074	1060	1084	1052	1086	1059
,, Sucrose, lbs. per gallon .	1.884	1.624	1.988	1.889	1.801	1.291	2.066	1.052	2.056	1.270
,, Glucose, lbs. per gallon ...	.069	.045	.156	.122	.131	.051	.158	.019	.089	.050
			Hybrids of 145 x Bourbon							
	145		Bourbon		145		Bourbon		145 x Bourbon	
Average Weight of one Cane in lbs.	5.2	4.7	4.1	3 6	9.6	3.0	12.6	1.7	5.2	3.2
Juice, Specific Gravity $\frac{30^\circ}{15.5}$ ...	1082	1080	1081	1078	1084	1052	1086	1052	1069	1066
,, Sucrose, lbs. per gallon ...	1.988	1.889	1.874	1.863	2 066	1.052	2.084	1.042	1.530	1.452
,, Glucose, lbs. per gallon ...	.156	.122	.166	.151	.158	.019	.333	.030	.178	.156
			Hybrids of 95 x Red Ribbon							
	95		Red Ribbon		95		Red Ribbon		95 x Red Ribbon	
Average Weight of one Cane in lbs.	2.5	2.0	4.8	1.8	Nil	Nil	3.7		5.8	
Juice, Specific Gravity $\frac{30^\circ}{15.5}$.	1090	1088	1082	1079			1072		1069	
,, Sucrose, lbs. per gallon ...	2.177	2.050	1.978	1.902			1.712		1.660	
,, Glucose, lbs per gallon ...	.042	.032	.055	.042			.040		.021	

TABLE VIII.—Continued.

	Parents.				*Seedlings, Ordinary.*				*Seedlings, hybrids*	
	Maximum.	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*	*Maximum.*	*Minimum.*
			Hybrids 625 x Red Ribbon							
	625		Red Ribbon		625		Red Ribbon		625 x Red Ribbon	
Average Weight of one Cane in lbs.	5.9	4.2	4.8	1.8	11.8	3.5	3.7		5.9	4.2
Juice, Specific Gravity $\frac{30^{\circ}}{16\ 6}$ ...	1074	1070	1082	1079	1082	1048	1072		1082	1072
,, Sucrose, lbs. per gallon ...	1.608	1.561	1.978	1.902	1.868	.994	1.712		1.910	1.645
,, Glucose, lbs. per gallon ...	.131	086	.055	.042	.196	.023	.040		.200	.056
			Hybrids 73 x Red Ribbon							
	73		Red Ribbon		73		Red Ribbon		73 x Red Ribbon	
Average Weight of one Cane in lbs.	6.3		1.8	1.8	Nil	Nil	3.7		12.2	4.0
Juice, Specific Gravity $\frac{30^{\circ}}{16\ 6}$ ...	1074		1082	1079			1072		1080	1056
,, Sucrose, lbs. per gallon ...	1.754		1.978	1.902			1.712		1.848	1.250
,, Glucose, lbs. per gallon ...	.017		.055	042			040		.131	.033

VARIETIES DIRECT FROM BOURBON.

Much attention has been devoted during recent years to raising new varieties directly from the Bourbon cane and from its earlier seedlings. During 1914 the numbers of those examined were:—

Bourbon	82
4399	98
4395	55
4397	54
216	30
293	14
317	11
721	9
294	8
604, 628, 4407, 642	19
	380

The range of variation in the new varieties of Bourbon parentage was very great:—

	Maximum.	*Minimum.*	*Mean.*
Average weight of one cane ..	16.3 lbs.	6.75 lbs.	2.5 lbs.
Juice, Specific gravity ..	1081	10685	1040
Sucrose, lbs. per gallon ..	1.915	1.466	.767
Glucose	.233	.066	.020

The more promising of the new (1912) seedlings of Bourbon strain are:—

Number of Variety.	Average weight of one cane per lb.	Per cent. by mill	Specific Gravity $\frac{17.5}{30}$	EXPRESSED JUICE. Pounds per Gallon: Sucrose.	Glucose	Solids, not Sugar.	Glucose ratio.	Quotient of Purity (apparent).	Quotient of non-sugar (apparent).
553	10.0	61.7	1073	1 723	.032	.205	3.59	86 6	10.3
650	10.6	64.1	1066	1.437	.078	291	5.42	79.6	16.2
655	12.2	67 1	1058	1.286	119	192	9.25	80 5	12.9
657	4.6	60.7	1080	1.874	.053	255	2.72	85 9	11.7
661	5 0	60.0	1081	1.894	034	.275	1.79	85.9	12.6
668	9.6	65.5	1068	1.588	059	.222	2 33	84.9	11 9
671	5.0	60.0	1078	1 915	.037	.170	1.93	90.2	9.1
684	7.2	58.1	1076	1.796	.038	243	2.17	86.5	11.7
688	12 6	64.5	1060	1 364	.043	257	3.16	81.9	15 5
693	7.6	56.5	1078	1 837	049	.237	2.66	86 5	11.2
702	6.3	64 5	1078	1 754	036	331	2.16	82 6	15 6
713	10.0	60.0	1068	1 545	.053	.271	3.43	82 6	14.5
714	7.3	63.6	1072	1.660	.042	259	2.53	84 1	13.2
716	9.0	55.5	1070	1.598	039	.278	2.44	83.4	14.5
733	7.8	59.6	1074	1 686	062	271	3.69	83.4	13.6
738	11.3	60.3	1062	1.369	.125	210	9.13	80.3	12.4
743	11.0	72.7	1071	1.593	078	.267	4.89	82.2	13.8
751	11.5	63.8	1056	1.239	.089	.213	7 18	80.4	13 8
762	12 0	64.6	1059	1.255	.104	.272	8.28	76.9	16.7
765	12.5	66.0	1058	1.312	.064	.221	4.88	82.2	12.8
786	12.3	63.3	1055	1.213	.141	.165	11.63	79.8	10.9
794	9.3	60 7	1074	1.666	.055	.298	3.30	82.5	14.8
795	12.5	62.0	1067	1.525	.069	.241	4.51	83.1	13.2
797	11 5	65.2	1073	1.634	.050	.306	3.06	82.1	15.4

TABLE IX.—Continued

Number of Variety.	Average weight of one cane per lb.	EXPRESSED JUICE. Per cent. by mill.	Specific Gravity $\frac{17.5}{30}$	Pounds per Gallon. Sucrose.	Glucose.	Solids, not Sugar.	Glucose ratio.	Quotient of Purity (apparent.)	Quotient of non-sugar (apparent)
799	10.8	66.2	1068	1.520	.071	.278	4.66	81.3	14.9
801	9.5	63.2	1064	1.447	.096	.212	6.63	82.4	12.1
808	6.6	62.5	1081	1.910	.057	.238	2.98	86.6	10.8
804	9.6	60.3	1070	1.645	.031	.237	1.88	85.9	12.5
813	11.0	62.1	1064	1.484	.067	.204	4.51	84.5	12.0
814	13.0	62.8	1057	1.208	.119	.242	9.85	76.9	15.6
824	8.0	62.5	1075	1.702	.057	.294	3.34	82.4	14.4
831	8.3	58.0	1078	1.822	.034	.267	1.86	85.8	12.6
832	11.5	65.2	1067	1.515	.034	.286	2.24	82.6	15.6
834	7.2	62.8	1074	1.697	.069	.253	4.08	84.0	12.6
840	14.8	69.7	1053	1.130	.109	.224	9.64	77.2	15.3
841	8.3	62.0	1072	1.671	.039	.251	2.33	85.2	13.2
847	7.2	58.1	1077	1.718	.078	.298	4.54	82.5	14.3
849	9.0	59.3	1069	1.577	.036	.279	2.23	83.3	14.8
851	9.6	58.6	1080	1.832	.045	.305	2.45	83.9	14.0
862	12.3	59.5	1069	1.566	.092	.234	5.87	82.2	14.7
870	9.7	58.9	1066	1.458	.096	.252	6.58	80.7	14.0
897	13.7	60.0	1059	1.270	.067	.294	5.27	74.2	18.1
908	10.0	58.8	1060	1.354	.071	.239	5.24	81.3	14.4
912	9.8	57.6	1065	1.432	.069	.289	4.82	80.0	16.2
914	13.5	61.7	1064	1.385	.092	.298	6.64	78.9	17.0
915	10.3	63.4	1062	1.364	.109	.231	8.00	80.0	13.6
917	8.3	60.0	1071	1.629	.043	.266	2.64	84.0	13.8
928	16.3	64.6	1062	1.336	.069	.297	5.16	78.5	17.5
938	7.6	63.0	1073	1.728	.032	.231	1.85	86.8	11.6

As a rule seedling canes derived from the Bourbon possess far greater vegetative vigour than does the parent cane which results in the production of many varieties characterised during the earlier years of growth by well marked development of the canes as regards size. The tendency is for varieties derived from the Bourbon to be relatively low in saccharose, yielding juice having a low quotient of purity and a high one of sugars. Few only of the Bourbon derivatives are characterised by high or even medium sugar-content. Of the 356 varieties examined 10 only yielded juice which as expressed by a laboratory mill contained over 1.8 lb. of sucrose per gallon whilst 2 only contained more than 1.9 lb. During later years of growth the canes produced are smaller in size but of higher and more satisfactory sugar-content.

Other varieties of which considerable numbers of new seedling kinds were examined gave the following results:—

ORDINARY SEEDLING VARIETIES.

Parent Variety.	*New Varieties examined.*	*New Varieties. with juice over 1.8 lbs. of sucrose per gallon.*
625 ..	.. 121 ..	.. 13
145 ..	.. 65 ..	.. 4
454 ..	.. 23 ..	.. 4
118 ..	.. 21 ..	.. 3
76 ..	.. 18 ..	.. 1
651 ..	.. 18 ..	.. 0
177 ..	.. 12 ..	.. 3
419 ..	.. 8 ..	.. 1

HYBRID SEEDLING VARIETIES.

Parent Variety.	*Hybrid Varieties examined.*	*Hybrid Varieties with juice over 1.8 lbs. of sucrose per gallon*
118 x 625 ..	.. 4 ..	.. 0
118 x 167 ..	.. 5 ..	.. 0
118 x 504 ..	.. 4 ..	.. 1
118 x 145 ..	.. 19 ..	.. 3
118 x 95 ..	.. 17 ..	.. 7
625 x 95 ..	.. 4 ..	.. 0
419 x 95 ..	.. 47 ..	.. 9

HYBRID SEEDLING VARIETIES.—(*Continued.*)

Parent Variety.	*Hybrid Varieties examined.*	*Hybrid Varieties with juice over 1.8 lbs. of sucrose per gallon.*
145 x 95	8	3
4395 x 95	2	0
419 x 145	7	3
145 x Bourbon	2	0
95 x Red Ribbon	1	0
625 x Red Ribbon	7	2
73 x Red Ribbon	9	2

There appears to be a larger proportion of sugar canes yielding juice of over 1.8 lb. of sucrose per gallon among the higher varieties than among ordinary ones. This may be due to the variety of high sucrose content, either 95, 145, 118 or Red Ribbon, selected in each case to be one of the parent kinds

AREA UNDER SUGAR IN THE COLONY.

The total area planted in canes in the colony in the year 1914 was 73,108 acres, an increase of 412 acres over that of the preceding year. The sugar crop of the colony was an average one As the crops of 1912 and 1913 had been adversely affected by the prolonged droughts of 1911 and 1912 it was expected that the 1914 crop would be larger than that of either of the two preceding years. The total export for the year was 107,138 tons, an increase of 19,724 tons over that of 1913, and of 29,350 tons over that of 1912. The total export of rum was 2,489,729 proof gallons, a slight increase over that of the previous year. The exports of molasses and molascuit showed a decrease, 83,197 gallons and 2,427 tons respectively being exported as against 118,699 gallons and 6,860 tons in 1913.

The returns submitted by sugar estates in the colony show that in 1914 more than 4/5 of the total area under sugar-cane was planted in varieties other than Bourbon Of the area cultivated in these varieties 85% was under canes raised from seed in this colony, while about 14% was occupied by varieties imported from Barbados. On many plantaitons the Bourbon is being planted principally on the best lands, the other lands being cultivated in seedling varieties—a practice which has much to recom-

mend it. Of the principal varieties cultivated in the 1914 crop eight yielded higher results than the Bourbon. The best of these varieties were D 625, Diamond 185, D 118, D 419, D 145, B 208 and B 147.

The following tables show the acreage under the principal varieties and yield of sugar per acre obtained from certain of the varieties during the crop of 1914 as reported by the sugar plantations:—

PRINCIPAL VARIETIES OF CANES, 1914 AND 1915.

Areas in English Acres.

Variety.	1914.	1915.	*Increase.*	*Decrease.*
D 625	32,686	36,922	4,236	— —
Bourbon	18,633	13,488	——	5,145
B 208	7,208	6,820	——	388
D 145	6,071	5,916	——	155
Diamond 185	1,502	1,791	282	——
D 109	2,272	1,748	——	524
Green Transparent	1,172	1,155	——	17
D 118	177	547	370	——
D 419	100	213	113	——
B 147	274	192	——	82
D 4399	78	105	27	——
D 116	165	100	——	65
D 4397	96	80	——	16
D 74	75	73	——	2
B 376	66	63	——	3
D 199	44	64	20	——
Java 1	43	60	19	——
D 216	41	54	13	——
D 108	17	51	34	——
White Transparent	48	14	——	34

RESULTS OF THE CULTIVATION OF THE PRINCIPAL VARIETIES OF SUGAR-CANE, CROPS OF 1914.

Variety of Sugar-cane.	*Number of Plantations reporting.*	*Tons sugar per acre.*
D 419	6	2.35
D 118	5	2.23
D 167	2	2.05
Green Transparent	6	2.03
D 4397	4	2.00

RESULTS OF THE CULTIVATION OF THE PRINCIPAL VARIETIES OF SUGAR-CANE, CROPS OF 1914.—(*Continued.*)

Variety of Sugar-cane.	*Number of Plantations reporting.*	*Tons sugar per acre.*
B 147 ..	.. 8 ..	.. 1.94
Diamond 185	.. 5 ..	.. 1.92
D 625 ..	.. 30 ..	.. 1.82
Bourbon	.. 20 ..	.. 1.80
D 145 ..	.. 24 ..	.. 1.74
D 3956 ..	.. 2 ..	.. 1.69
D 4399 ..	.. 2 ..	.. 1.59
B 208 ..	.. 20 ..	.. 1.56
D 109 ..	.. 11 ..	.. 1.33

INSECT PESTS.

The Economic Biologist reports regarding the pests of the sugar-cane:—

" *Sugar-cane.*"

" Various methods of control against the variety of in- " sects which damage this crop have now been fully tested " and a regular system is in use on the majority of the " estates.

" A regular gang is employed, the members of which are " employed as regularly as possible. A certain degree of " skill and knowledge of the work is thus acquired by these " people which is very desirable. The cutting out of dead " hearts, collection of the egg masses of the Small Moth " Borer, destruction of *Castnia* larvae and pupae in re- " cently cut fields and the occasional destruction of minor " pests such as leaf eating worms and hardbacks form the " regular duties of such a gang.

" During certain seasons traplights for the destruction " of the adult forms of the two species of small moth borer " (as advocated in a previous report of the Biological Di- " vision) have been used with considerable success on some " estates.

" The collection of parasitized egg masses and their re- " distribution in the fields has been seriously undertaken " in some instances but the quality of such work is gener- " ally greatly depreciated owing to the lack of supervision " by a trained and competent person. Speaking from per-

"sonal observation it is significant that where such super-
"vision exists the best results are obtained and the yields
'of sugar per acre are among the highest in the colony.

"However, all-round progress can be recorded and it is hoped that the general rise of prices owing to the war in "Europe will persuade those concerned to further extend "this side of the work. As an investment the returns may, "on a casual inspection. appear small and hardly worth "while, but careful investigation will fully show the entire "fallacy of such views

"No new really serious sugar-cane pests have appeared "though perceptible increases in Froghopper (*Tomaspis* "*flavilatera* Urich) and hardbacks (*Dyscinctus bidentatus* "Burm.) should be recorded.

DISEASES OF THE CANE.

The principal disease affecting the sugar-cane during the year was the root disease, also termed the "new" or "dry disease" caused by *Marasmius sacchari*. This was, however, present in smaller quantity than in the previous year The rind diseases, caused by *Tricosphaeria sacchari* and *Melanconium sacchari*, were fairly prevalent though conideralbly less damage was attributable to these than to the root disease Next in importance were the "pineapple disease" (*Thielariopsis ethaceticus*) of sugar-cane cuttings and the rot due to *Diplodia*, the latter affecting principally the ripe cane. Leaf diseases were for the most part not abundant, the only one worthy of mention being the spotting caused by *Cercospora vaginae*.

"Vomiting Sickness."

It is observed in a report by Dr H. H. Scott (Jamaica) that this disease corresponds exactly with the main ackee season, when other fruits and natural foods are relatively scarce. Last year the ackee season continued longer than in previous years. Instead of ending in March or early in April they have been abundant till well on in May, and vomiting sickness cases have been reported in greater numbers than in the previous year, for example, and over a more prolonged period This has been noticed for three or four years past.

—"The Colonial Journal," October, 1915.

The Birds of British Guiana.

By Charles B. Dawson, S.J., M.A., (Oxon.)

II.

PARROTS.

Under this head are included the following:—

Macaws, peculiar to the Neo-Tropical regions; *Cockatoos*, peculiar to the Australian regions; *Nestors* of New Zealand, including the Kea which has recently becoming carnivorious, making havoc among sheep by digging into their kidneys for the sake of the fat; *Lorics* of New Guinea and the Malay Archipelago; besides *Parrots* proper, *Parakeets* and *Loev-birds* found, with few exceptions, in all Tropical regions, though each with its peculiar orders and species.

Parrots are the most intelligent of all the feathered tribes. Possessing proportionately more brain than all the other birds, easily domesticated, prettily or even gaudily coloured, knowing in their ways, and with a wonderful capacity of imitating sounds and even the human voice, they are everywhere popular as pets and familiars.

Characteristics of the whole family are: round heads, zygodactyl feet, a highly dilatable iris, a fleshy tongue, and (what is common to no other bird), a pincer-like beak with a moveable maxilla (upper beak) and the use of the foot as a hand. We may also add "powder-down patches" which give to certain parrots when in good health the appearance of being covered with bloom. There are in all seventy-nine genera, including five hundred and seventy species, two hundred of which belong to the American Continents; one species, the Carolina Parakeet being found in the United States.

The food of parrots consists of fruit, nuts, berries, and seeds. Lories feed on honey which they extract from flowers with their brush-tipped tongues; the Kakapo or Owl parrot of New Zealand will add lizards to its bill of fare and the Nestors, insects and their larvæ; while certain Cockatoos will dig in the earth for roots and tubers.

Parrots pair for life, but congregate in great numbers at their roosting places where they make a deafening noise. The sexes are generally alike, the males being larger and more brightly coloured; but in one species, the Electus of New Guinea, the male is green with red sides, and the female has head, breast, and upper parts bright red. Parrots generally make their nests in holes of trees which they will whittle out with their powerful beaks. Therein are laid the spheroid eggs, white or with a greenish or bluish tinge. They are long-lived.

PARROTS—(Colonial). *Psittacidae.*

Red and Yellow Macaw	*Ara Macao.*
Red and Blue ,,	,, *chloroptera.*
Blue and Yellow ,,	,, *ararauna.*
*Green ,,	,, *severa.*
Eta ,,	,, *macaraauna.*
†Red-fronted Green Macaw (Hahni's)	,, *hahni.*
Brown-throated Parakeet	*Conurus aeruginosus.*
*†Scarlet-tipped ,, (bright-eyed)	,, *leucophthalimus*
Kissi-Kissi ,,	,, *solstitialis.*
Golden-fronted ,,	,, *aureus.*
Scaley breasted ,,	*Pyrrhura picta.*
Red-winged ,,	,, *egregia.*
*†All-Yellow ,, (Roraima Mt.)	*Bolborhynchus panychlorus*
* (human-voiced)	*Brotogerys tirica.*
Golden-winged Parakeet	,, *chrysopterus.*
†Green red-rumped ,,	,, *tuipara.*
Black-winged Parakeet	*Urochroma cingulata.*
†Purple-clad ,,	,, *purpurata*
	,, *henti.*
Amazon Parrot	*Amazona ochrocephala.*
Yellow-cheeked Amazon (Screecher)	,, *amazonica.*
Blue-cheeked Amazon (Culu-culu)	,, *dufresneana.*
Green Amazon (Saurama)	,, *farinosa.*
*	,, *bodini.*
Red-backed Amazon	,, *festiva.*
White-capped ,,	,, *aestiva.*

Blue-headed Parrot	*Pionus menstruus.*
Dusky "	" *fuscus.*
†Fan-crested, or Hawk Parrot (Hya-hya)	*Deroptyus accipitrinus.*
Black-headed Parrot	*Pionopsittacus caica.*
White breasted Parrot (seven-coloured)	*Pionites melano cephalus.*
*†All-green Love-bird	*Psittacula modesta.*
Guiana "	" *guianensis.*
†Sparrow "	" *paperina.*

TOUCANS.

Toucans or *Bill-birds,* as they are called in this colony, are easily recognised by their enormous beaks. What particular end these strange beaks serve were difficult to say, but it may be remarked that toucans can pick off a small berry or fruit with the greatest precision. The beaks, though so large, are of feather weight, being composed within of a delicate net-work of a light bony substance with air-spaces. They are generally notched or serrated and the tongue, which is long and arrow-like, has feather-like margins. In some species they are glossy black with margins of delicate blue or yellow; in others, brilliant red, golden yellow, or faded green are the predominant tones. The prevailing colours of the plumage are black or dark green above, white throats or gorgets, with bands or markings of gaudy reds and yellows. The orbits are bare, the skin being delicately tinted with blue, red, or lilac. In sleep, the long square tail is turned over the back and the great bill rested upon it. The feet are zygodactyl.

Toucans are forest birds and generally to be found on the tops of trees They feed on berries and fruit, with lizards and small mammals, or birds, which they tear to pieces before swallowing. They will fling the morsel in the air and catch it with open mouth. They make their nests in holes of trees and lay white eggs. They are easily tamed and make amusing pets. Their cry is as strange as themselves; some croak with heads thrown back, others yelp like a dog; their note of anger or alarm is like a wooden rattle.. They are awkward on the ground, hopping in an ungainly fashion Their flight is somewhat laboured and undulating, the bill thrust forward. There are in all sixty species, all confined to the Neo-Tropical regions.

TOUCANS.—(Colonial.) *Rhamphastidae.*

The Great Toucan (white-breasted)	*Rhamphastos*	*toco.*
Red-beaked Toucan	„	*erythrorhinchus.*
*†The Kissi-Kissi „	„	*osculans.*
Saffron-breasted „	„	*vitellinus.*
†Two-coloured „	„	*dicolorus.*
†Red-cinctured „	*Pteroglossus*	*aracari.*
*†Letter-billed „	„	*inscriptus.*
†Many-banded „	„	*pluricinctus.*
Green „	„	*virdis.*
†Ear-tufted or Black-breasted Toucan (pepper-eater)	*Selenidera*	*piperivora.*
†Many-coloured Toucan	„	*nattereri.*
†Sea-green Toucan (Whiteley's)	*Aulacorhampus*	*Whitelyanus.*
†Furrow-billed Toucan	„	*sulcatus.*
†Double ring-necked Toucan	„	*bitorquatus*

CUCKOOS

Cuckoos have affinities to Parrots and are placed by some ornithologists in the same order. Outwardly, however, they are very different and agree only in having zygodactyl feet The beak is generally long and curved, and in the "Old Witch" the maxilla is raised in the form of a keel. The plumage also differs much from parrots, in being of sombre hue, brown, greys, or buffs being the prevailing tints, with sometimes bars or spots of white or black. In all there are forty-six genera and some two hundred species, of which about thirty species belong to America. Cuckoos differ from other birds in being promiscuous in their intercourse, polyandry being generally practised, but the habit of the English Cuckoo of laying its eggs in other birds' nests and thus relieving itself of the burden of domestic life, is not common to the order. Most other Cuckoos build their own nests and raise their progeny. In the case of the "Old Witch," however, one large nest serves the purpose of several females who sit side by side and share in common the duty of incubation. The food of

Cuckoos consists of caterpillars and insects generally; some will eat fruit and berries; others, lizards, small snakes and even birds and mice. Their cry is loud and shrill, but none in these regions utter the note that has given the name to the whole family. Some species have striped, hawk-like breasts as also a hawk-like flight and are in consequence often mobbed by other birds. In this colony the Cuckoo's habit of depositing its eggs in the nests of other birds is taken up by the Lazy-bird, and its affinity, the great Corn Bird, both belonging to the Order "Icteridae," *q.v.*

CUCKOOS.—(Colonial). *Cuculidae.*

Black-billed Cuckoo	*Coccyzus melanocoryphus*
Grey-breasted „	„ *americanus.*
„ „ (lesser) Cuckoo	„ *minor.*
* Cuckoo (Euler's)	„ *euleri.*
Brown „	*Piaya cayani.*
Red-billed Cuckoo (black-bellied)	„ *melanogastra.*
Small Brown Cuckoo	„ *minuta.*
Red-winged „ (scale-nosed)	*Neomorphus rufipennis*
Spotted Cuckoo (or wife-sick bird) (large-winged)	*Diplopterus naevius.*
Brown-Headed Cuckoo (peacock-like)	*Dromscoccyx pavoninus.*
†Keel billed Purple-black (Gt. Old Witch)	*Crotophaga major.*
„ „ smaller black (Old Witch Bird)	„ *ani.*
†Furrow-billed Cuckoo	„ *sulcirostris*

WOODPECKERS.

These birds are found all over the world except in Australia, Madagascar, and Egypt. They may be recognised by their large heads, often decorated with a scarlet tuft, their wedge-shaped and powerful beaks, their necks, spiny tails and zygodactyl feet. Browns, greens, yellows, with markings of scarlet and spots or bars of black and white are the prevailing colours. They are rightly called "scansorial" for they ascend the trunks of trees with great

agility either using their claws or, if the trunk is slender, clipping the trees, as it were, astride. With their powerful beaks they can easily chisel a hole in the hardest wood; and with their highly protrusible, worm-like tongues, which are tipped with a barbed spine, they extract insects and their larvae from narrow holes or crannies. Their loud and rapid tapping may be heard for a mile. They make their nests in deep holes of trees which they hollow out with great precision and symmetry; here they lay white, glossy, oval eggs. When at work, they rest back upon their hard, spiny tails, and as easily descend as ascend, preserving their upright position. They are shy birds and so not often seen; but their loud note, or derisive laugh, ringing through the forest, when once heard is not easily forgotten. Their flight is swift and undulating. There are fifty genera, including four hundred and forty species of which about half are peculiar to the New World.

WOODPECKERS.—(Colonial.) *Picidae.*

†Head-streaked Woodpecker			*Chloronerpes*	*capistratus.*
Yellow-throated	,,		,,	*flavigula.*
Red-cheeked	,,		,,	*rubiginosus*
*†Speckled-throated	,,		*Chrysoptilus*	*punctigula.*
†Blood-crowned (Yellow-naped)	,,		*Melanerps*	*cruentatus.*
†Ruby-fronted (Lesser Black)	,,		,,	*rubrifrons.*
Ruddy	.		*Veniliornis*	*sanguineus.*
*†Sparrow	,,		,,	*passerinus.*
†Helmeted	,,	(?)	,,	*cassini.*
Red-rumped (Kirk's)	,,	(?)	,,	*kirki.*
Yellow-crested Brown Woodpecker		(?)	*Celeus*	*reichenbachi.*
Fine-spotted yellow-brown Woodpecker		(?)	,,	*elegans*
Red-cheeked Woodpecker		(?)	*Jumana*	,,
Brown Woodpecker			,,	*rufus.*
†Striped	,,	(?)	,,	*grammatica.*
Brown-breasted Woodpecker (collared)			*Cerchneipicus*	*torquatus.*

Yellow Woodpecker	*Crocomorphus flavus.*
†Scarlet-headed Woodpecker (red-necked)	*Campo philus rubricollis.*
Black-throated Woodpecker	„ *melanoleucus*
Scarlet-crested Woodpecker (stripe-breasted)	*Ceophloeus lineatus.*

Picumninae—

Pigmy Woodpecker or Piculet (spotted bellied)	*Picumnus spilogaster.*
Pigmy tufted Woodpecker	„ *cirrhatus.*
† „ scaly „ (?)	„ *lepidotus.*
Small „	„ *minutus.*
†Wavy-striped „	„ *undulatus.*

ANT-THRUSHES.

These birds were so named on the supposition that they feed as thus signified. But they are not known to eat ants and probably none of them do so. They may be seen pecking among fallen leaves where ants abound, but they are in search of other insects. Few, if any, birds feed on ants, except, perhaps, Woodpeckers. . .

Ant Thrushes are generally the size of Thrushes, hence their second appellation. They are shy birds, hiding among shrub and bushes, consequently their habits are little known. Their colours also aid them in their obscurity. browns and reds with bars, stripes, patches or spots of black and white being the prevailing tones of the colonial species. The sexes are much alike, but in those which are black or grey, the females are correspondingly rufous. Their voice is loud and shrill, the same note being repeated in a long metallic trill. The common Check-bird may be taken as typical. Not quite the size of a Thrush, it has a sturdy body, a fairly long, stout, beak and simple square tail. In colour, it is dull black with narrow, regular, stripes of white; the hen is similar but rufous. Many of these birds build nests of fibre and swing like hammocks among the branches.

Gnat eaters.—It will be convenient to group with the Ant Thrushes the two examples of "*Conopophagidae*" (gnat-eating), the *Conopophaga aurita*—"the eared gnat-eater"; as also *Corythopis anthoides*, "the crested gnat-eater," both of which may possibly be found in this colony. Their habits

would seem to be unknown. Like the Ant-thrushes they are probably insectivorous. They have long, loose, rump-feathers. In all there are thirty-eight genera of these useful birds, including some three hundred and forty species; all are peculiar to the New World. Of Gnat-eaters there are two genera and sixteen species.

ANT-THRUSHES.—(Colonial). *Formicariidae.*

Striped Ant-Thrush	*Cymbilanius lineatus.*
Grey Bush Shrike	*Thamnophilus viridis.*
White-breasted Bush Shrike	,, *major.*
Grey-black ,, ,,	,, *cinereo-niger.*
†Starred ,, ,, (?)	,, *stellaris*
*†Mouse-like ,, ,,	,, *murinus.*
†Freckled ,, ,,	,, *naevius.*
*†Red-necked ,, ,,	,, *ruficollis.*
†Night-grey ,, ,,	,, *cinereinucha.*
†Beautiful ,, ,,	,, *insignis.*
Black-breasted ,, ,,	,, *cirrhatus.*
Common Check-Bird ,,	,, *doliatus.*
Bush (grey-marked) Ant-Thrush	*Dysithamnus spodionotus.*
,, (cloven) ,,	,, *schistaceus.*
†Ruddy-red Ant-Thrush	,, *ardesiacus.*
†Bluish-grey Bush Sprite	*Thamnomanes glaucus.*
*Pigmy Ant-Bird	*Myrmotherula pygmea.*
*	,, *surinamensis.*
†Spotted ,, ,,	,, *guttata.*
*†Speckled ,, ,,	,, *gutturalis.*
†Fire spotted Ant-Bird (?)	,, *pyrrhonota.*
†Hooked-(billed?) ,, ,,	,, *axillaris.*
*†Long-winged ,, ,,	,, *longipennis.*
*†Unadorned ,, ,,	,, *inornatus.*
	,, *unicolor.*
†Ash-vented ,, ,,	,, *cinereiventris.*
†Spotted-backed ,, ,,	,, *dorsimaculatus.*
†Pearl-grey ,, ,,	*Formicivora grisea.*
Coal-black ,, ,, (?)	,, *consobrina.*
*†Smooth-ashen-feathered Ant-Bird	*Terenura spodioptila.*

†White-vented Ant-Bird	*Rhamphocaenus albiventris.*
†Collared neo-crooked Ant-Bird (?)	„ *collaris.*
*†Grey Spotted-tailed Ant-Bird	*Cercomacra cinerascens.*
*†Wood Spotted-tailed Ant-Bird	„ *napensis.*
*†Tyrant Spotted-tailed Ant-Bird	„ *tyrannina.*
†White-crested Ant-Bird	*Pithys albifrons.*
*†Red throated (bare)	*Gymnopithys rufigula.*
†Black-throated (bush-lover)	*Rhopoterpe torquata.*
†Sclater's freckled Ant-Bird	*Sclateria naevia.*
†Bright-spotted Ant-Bird	„ *leucostigma.*
†Silvered „ „ (?)	„ *saturata.*
†Swainson's Wood-lover Ant-Bird	*Drymophila swainsoni.*
†Cinnamon Ant-Bird	„ *cinnamomea.*
*†Black-throated Wood-lover	„ *atrothorax.*
†Pelzeln's Wood-lover (?)	„ *pelzelni.*
*†Singing Ant-Thrush (under-legged)	*Hypocnemis cantator.*
†Yellow Ant-Thrush (under-legged) (?)	„ *flavescens.*
†Scale-backed Ant-Bird	„ *poecilonota.*
†Scaly „ „	„ *lepidonota.*
†Shiny „ „	„ *leucophrys.*
†Black-faced „ „	„ *melanopogon.*
†Red-winged „ „ (?)	*Phlogopsis erythroptera.*
Rufous-headed Ant-Bird	*Formicarius colma.*
Black-necked „ „	„ *nigrifrons.*
†Brown „ „	„ *crissalis.*
*†Yellow, ground „ „	*Chamaeza fulvescens.*
†Mottled „ „	*Grallaria varia.*
*†Short-tailed „ „	„ *brevicauda.*
†Blotted „ „	„ *macularia.*
*†Dwarf „ „	*Grallaricula nana.*

Conopophagidae—

Eared-Gnat-eater (?)	*Conopophaga aurita.*
*White-throated Gnat-eater	*Corythopis anthoides.*

WOOD-HEWERS.

Wood-hewers, like ant-thrushes are a large and little-known family, and like them, are peculiar to the New World There are no less than fifty genera and four hundred species. They do not precisely "hew" the wood and would be better called "wood-peckers" were this name not already in possession of birds that might lay better claim to theirs. They might be better named "wodpeckers," for they run with great ease about the trunks of trees picking out insects and their larvae from holes and crevices. When the trunk of the tree is slender they will ascend or descend, sitting as it were astride, and clipping the tree with the sides of their feet with great adroitness, much in the manner of wood-peckers. They vary in size, the largest being a foot long; but generally they are only half that size. Red, rufous, or chestnut, are the prevailing colours, while the head and neck may be streaked or freckled with light buff or white, and there may be white or black patches on rump or throat respectively. The tail feathers, generally rounded, have in mny cases projecting spines, like those of wood-peckers, which materially assist the bird in ascending or descending trees; and on them it can rest back during its "wood-hewing" operations. The beak may be long and curved, in one species, *Xiphorhynchus procurrus*, enormously so. They build their nests, sometimes great structures, in trees and shrubs or in holes of trees or banks. The sexes are similar. The voice is sometimes loud—the note being rapidly repeated in a descending trill—and sometimes rasping or chattering.

WOOD PICKERS OR WOOD-HEWERS.—(Colonial). *Dendrocolaptidae*

White-faced Wood-Hewer (?) (earth chit)	*Geositta leucopus.*
*Coppice Wood-Hewer (wood)	*Lochmias nematura.*
Fronted Wood-Hewer (social)	*Synallaxis frontalis.*
Brown-tailed Wood-hewer	" *brunneicaudalis.*
Whitish "	" *albescens.*
Guiana "	" *guianensis.*
Rootie or Red "	" *cinnamomea.*
*Swarthy Wood-Hewer (Roraima)	" *adusta.*

Thrush-like Worm-eater (?)	*Automolus turdinus.*
White-throated Worm eater	„ *albigularis.*
* (Sclater's)	*sclateri.*
*Fire rose Water Worm-eater	*Philydor pyrrhodes.*
Red tailed Water Worm-eater	„ *erythrocercus.*
Spotted-breasted Worm-eater (?)	„ *cervicalis.*
Cheek-bearded Worm-eater	*Xenops genibarbis.*
*Sharp-tailed Worm-eater	*Sclerurus candacutus.*
Wedge-billed Worm-eater	*Glyphorhynchus cuneatus.*
*Long-tailed Wood carver	*Deudrocichla longicauda.*
Resplendant Worm-eater	„ *gulginosa.*
Olive „ „	„ *olivacea.*
*Merle „ „	„ *merula.*
Spotted Wood-Bird	*Dendrornis guttatoides.*
*Pale-billed Wood-Bird	„ *rostripallens.*
Pard-spotted „	„ *pardalota.*
*Much-spotted „	„ *polysticta.*
Much-speckled „	„ *multigutata.*
White throated Tree-weaver	*Dendroplex picus.*
Wood-hewer (?)	*Dendrexetastes temmincki.*
Thick-billed Wood-hewer (?)	*Hylexetastes perroti.*
Spot-headed Wood-Bird	*Picolaptes puncticeps.*
White-lined „	„ *albolineatus.*
*Long-beaked „	*Nasica longirostris.*
Curve-billed „	*Xiphorhinchus trochilirostris.*
*Slightly Curved-bill Wood-Bird	„ *subprocurrus.*
Large Wood-hewer	*Deudrocolaptes plagosus.*
Broad-billed „	„ *certhia.*
*Bar backed „	„ *radiolatus.*

SUGAR BIRDS.

These charming birds were so called from their habit of fearlessly visiting sugar factories in pursuit of the flies that swarm in such places. In outward appearance, with their long beaks and forked tongues, they resemble humming-birds; their plumage however, though very beautiful, lacks the metallic lustre of *Trochilidae*. They number some twelve genera and upwards of a hundred species, all peculiar to Neo-Tropical and Sub-Tropical regions. In company with Humming-Birds they probe flowers for honey. or like fly-catchers, dart after flies on the wing; or like tree-creepers, search the bark of trees for insects. Velvet-like or purple, relieved by brilliant patches of sky-blue, white, or yellow, are the prevailing tints; while the hens are often dull olive or green. From their note they have acquired the colloquial name of Quit-quits. They build a rough, domed nest of grass, moss, roots, etc., and deposit therein from two to four white, or greenish eggs, with blotches or specks of rusty-red. They are easily tamed, and from the fearless nature and pretty plumage, soon become great pets; but on account of difficult feeding they do not ordinarily live long in cages.

SUGAR-BIRDS OR QUIT-QUITS. (Colonial).—*Coerebidae.*

†Blue-capped Sugar-Bird		*Coereba (Certhiola) guianensis.*
Yellow-breasted Sugar-Bird		„ „ *chloropyga.*
Hook-billed	„ „	*Diglossa major.*
Blue	„ „	*Dacnis cayana.*
†Angelic	„ „	„ *angelica.*
Purple-blue	„ „ (?)	„ *analis.*
Black-headed	„ „	*Chlorophanes spiza.*
†Purple & Black	„ „	*Cyanerpes (Coereba) caeruleus.*

HUMMING BIRDS.

These small but wonderful creatures excel all other birds in their power of flight, and rival precious stones in the lustre of their colour patches. Some are adorned with crests, ear-tufts, frills, or pendents; and in some species the tiny feet emerge from little puffs of snow-white feathers. The wings are long, but narrow, and the tail sometimes

assumes fantastic shapes. They were happily named *Trochilidae* from a Greek word denoting the swift spinning roller of a windlass; for their wings, moved by powerful muscles, whirl with the rapidity of the propeller of an aeroplane, as they dart like insects from flower to flower.

The humming of their wings may be heard for several yards and is frequently accompanied by a continual twittering. To sustain the powerful muscles of the wings, the breast-bone is enormously developed and shaped like the keel of a racing yacht. It will be noticed that the beak is abnormally long, in some species even longer than the body, and sometimes serrated. The tongue also is very long and can be protruded to a long distance; it is a double tube, forked at the end like a snake's. The bird is thus able to suck honey from flowers as it poises horizontally before them on almost invisible wings. The tail meanwhile opens and shuts like a fan, or is moved laterally from side to side. Its food consists, besides honey, of small insects which it collects from leaves and flowers.

These tiny creatures are fearless birds and will drive off intruders ten times their size, darting at them with lightning rapidity, their beaks held out stiff like a knight's lance.

The tiny nest is a fairy-like structure of felted wool and cobwebs, often tastefuly adorned with lichens; it lays but two white eggs, or only one.

All these birds belong to the New World, their nearest approach in beauty and habits being the Sun-Birds of India and the East; but these latter are normal in their flight and must creep about the flowers in pursuit of their food. There are in all a hundred and seventeen genera, including some five hundred and seventy species. The females are generally much inferior in colouring to the males, and lack their feathered adornments.

HUMMING BIRDS.—(Colonial). *Trochilidae.*

Blue-fronted Lance-Bill	*Hemistaphania johannae.*
White-tailed Barbthroat (mourner)	*Threnetes leucurus.*
*Bronze-green Hermit	„ *antoniae.*
Rugged Brown Humming Bird	*Glaucis hirsuta.*
*†Guiana Radiant „	*Phaethornis guianna.*

Eye-browed Humming Bird	*Phaethornis superciliosus.*
†Majestic Radiant	„ *augusti.*
Hermit Humming Bird	„ *bourcieri.*
*Rupuruni Radiant	„ *rupuruni.*
* „	„ *longuemareus*
*Bishop „	„ *episcopus.*
Sabre-wing Humming Bird	*Campylopterus largipennis.*
*†Reddish Humming Bird	„ *hyperythrus.*
Jacobin (or white-naped) Humming Bird	....
(honey-eater)	*Florisuga mellivora.*
*Emerald	*Agyrtria whitelyi.*
†White-vented Pilgrim (beggar)	„ *leucogaster.*
Ultra green Pilgrim	„ *viridissima.*
* †Spotted-tailed „	„ *maculicauda.*
*Bright-tailed „	„ *nitidicauda.*
†Copper-tailed Dainty	*Saucerottea cupreicauda.*
*Green-vented Wood-beauty	*Hylocharis viridiventris*
Red throated Sapphire	„ *sappirina.*
Blue-chinned Sapphire	*Chlorestes coeruleus.*
*†Forked-tailed golden dwarf (Mt. Roraima)	*Chlorostilbon subfurcatus.*
†Festive Fork-tail Wood-Nymph	*Thalurania furcata.*
†Waterton's Humming Bird	„ *watertoni.*
*†Ear-tufted Humming Bird (Mt. Roraima) Shade bearer	*Petasophora germana.*
Dolphin Ear-tufted Humming Bird	„ *delphinae.*
Fiery-tailed Avocet	*Avocettula recurvirostris.*
†Violet-tailed Torch Humming Bird	*Lampornis violicauda.*
Green-throated Torch Humming Bird	„ *gramineus.*
†Gold-shining Mosquito Humming Bird	*Chrysolampis mosquitus.*
†Emerald Teresa Green-tail	*Psilomycter theresiae.*
†Graceful Wonder	*Polytmus thaumantias.*

King Topaz	*Topaza pella.*
†Yellow-breasted golden-glory	*Heliodoxa xanthogonys*
Golden Long-ear	*Heliothrix aurita.*
Tuft-crested Coquette	*Lophornis ornatus.*
†Rocket-tailed Quoit	*Discura longicauda.*

SWIFTS.

The resemblance of Swifts to Swallows is only superficial, Anatomically, the difference is fundamental, and Swifts have been finally placed in the same sub-order as Humming Birds. They are emphatically birds of the air, performing all their functions on the wing and never resting except to roost. Like Humming-Birds they have enormous keels bearing the powerful muscles that sustain them in their continual flight. Their feet, unlike all other birds, except a few species of Night-jars, are generally *pamprodactylous,* that is, all four toes are in front, and in some examples even the toes are feathered. Their coloration is generally sombre, blacks and browns with sometimes white chins, breasts, or rumps. and markings of rufous, being the prevailing tints. They range all over the world except in New Zealand, and some other islands, and in snow-bound latitudes. Their tails are generally forked; and in flight they resemble a bent bow. Their note is a shrill scream uttered continuously. The *Collocalia* make their nests of secretions of their salivary glands and from them the Chinese concoct excellent soup! None of these species, however, belong to the New World. Others make their nests saucer-shape, of twigs, straw, feathers, etc., which they catch in the air as they fly, binding the material together with saliva, and selecting such sites as the face of a cliff. the open branch of a tree. palm leaves, etc. The *Panyptila* makes a huge nest entirely composed of seeds, glued together with saliva. The eggs are dull white like those of Humming-Birds. They are in all nine genera and a hundred species, of which twenty-five belong to the New World.

SWIFTS—(Colonial). *Cypselidae.*

*†The Belted Swift		*Chaetura*	*zonaris.*
*† „ White-banded Swift		„	*albicincta.*
*† „ Spiny-tailed	„	„	*spinicauda.*
*† „ Grey	„ (?)	„	*poliura.*

*†The Ash-vented Swift	*Chaetura cincreiventris*	
*† „ Grey-breasted „	„	*guianensis.*
† „ Ruddy „(?)	*Cypseloides rutilus.*	
*† „ Black „	„	*niger.*
„ Smoky „	„	*fumigatus.*
„ Palm Swift (Scaly)	*Claudia squamata.*	
„ Cayenne „ (downy)	*Panyptila cayenensis.*	

SWALLOWS & MARTINS.

These birds belong to the Order *Passeriformes* and are placed next the Swifts in this collection for the sake of comparison. Like Swifts they are cosmopolitan and their habits are generally the same, feeding on insects which they catch with open mouth. They will alight on the bare branches of trees and are sometimes seen on the ground collecting mud to build their nests which may be cup-shaped or like a retort with a tube for entrance. They often form colonies of nests and hunt in companies. In colour they resemble Swifts: blue blacks, with puff, and under-parts generally white; there may be chestnut or reddish markings. They twitter or warble, both on the wing and at rest. The eggs, from four to seven, are white in Martins, and white with red spots or purple markings in Swallows. Martins are generally smaller than Swallows and the colouring is not so bright. Many of them are white-rumped. Sand Martins build their nests on the face of cliffs, digging holes in the soft clay or sand; the Purple Martin of N. America, in holes of trees. There are in all thirteen genera, including more than a hundred and thirteen species, of which twenty-six belong to the New World.

SWALLOWS & MARTINS. (Colonial)—*Hirundinidae.*

White-vented Swallow (Quick-flyer)	*Tachycineta albiventris.*	
Chimney Swallow (red-vented)	*Hirundo erythrogaster.*	
Chalybeate Swallow (iron-blue)	*Progne chalybea.*	
Brown Swallow	„	*tapera.*
†Elegant-banded Swallow	*Atticora fasciata.*	
Ash-throated „	„	*melanoleuca.*
*†Dark-blue bright „	„	*cyanoleuca.*
†Capped „	„	*pileata.*
†Forked „	„	*fucata.*

Red-throated
(scraper-winged) *Stelgidopteryx ruficollis.*
* " *uropygialis.*

CHATTERERS.

These are forest birds, feeding upon berries and seeds, with insects and even lizards. They are all peculiar to the Neo-Tropical regions and include some of the most gorgeously coloured birds in the world; such as the Crimson Cotinga, the Fire-Bird, the Pompadour Cotinga, the Purple-throated Chatterer, etc.; and some of the most remarkable: as the Cock-of-the-Rock, Umbrella Bird, and the Campanero or Bell-Bird. They vary in size, the Bald Cotinga being as large as a crow and like it in appearance, others as small as a Sparrow. The Cock-of-the-Rock has the habit of displaying himself before the females after the manner of *Galliformes.* The Campanero, which lives in the tops of high trees utters a double note, resembling the striking of a hammer upon an anvil, which may be heard for three miles. It has a hollow corunncle in its bill which it will inflate with air and erect for several inches; but this has nothing to do with its bell-like note. The Umbrella-Bird is black and has a permanent crest as described: the Greenheart Bird utters a triple ringing note that resounds through the forest. Some of the Cotinga have bare orbits or patches. There are some thirty genera including a hundred and sixty species Little is known of their habits The Cock-of-the-Rock makes its nest of stick and mud on some projections of rock within a cave and therein lays two eggs of buff, spotted with red and purple; others build in trees.

CHATTERERS. (Colonial).—*Cotingidae.*

Black-headed Cotinga *Tityra cayana.*
*†Spy " " *inquisitor.*
Rosy-throated " *Platypsaris minor.*
*†Grey-throated green-backed Broad-billed Cotinga *Pachryhamphus griseigularis.*
*White-vented " " *surinamus.*
†Ash-coloured Cotinga " *cinereus.*
†Black " " *niger.*
†Dark-coloured " " *atricapillus.*

Greenheart-Bird (shy-bird)	*Lathria cinerea.*
*Wreathed Cotinga	,, *streptophora*
Grey Cotinga (flute playing, reddish)	*Aulia hypopyrrha.*
*†Dusky Cotinga	*Lipaugus simplex.*
*†Foul ,,	,, *immunдas.*
Yellow-back Cotinga	*Attila uropygialis.*
*†Ash-breasted ,,	,, *spodiostethus.*
Rufus Cotinga (bush-lover)	,, *thamnophiloides*
Fire Bird	*Phoenicocercus carnifex*
Cock-of-the-Rock	*Rupicola rupicola.*
Coral-billed	*Pipreola whitelyi.*
Purple-breasted Cotinga	*Cotinga cotinga.*
Purple-throated ,,	,, *cayana.*
Pompadore ,,	*Xipholena pompadora.*
*†White-white ,, (rusty-sided)	*Iodopleura leucopygia.*
Manakin ,,	,, *pipra.*
Small dusky ,,	,, *fusca.*
Crimson ,,	*Haematoderus militaris.*
Crimson-throated ,,	*Querula cruenta.*
Crimson-breasted ,,	*Pyroderus orenocensis.*
*†Umbrella-bird ,,	*Cephalopterus ornatus.*
Bald Cotinga or Quow	*Calvifrons calvus.*
Blue necked Cotinga (naked-throated)	*Gymnoderus foetidus.*
Bell Bird (hollow-beaked)	*Chasmorhynchus niveus.*
†Spotted hollow-beak	,, *variegatus*

MANAKINS.

These birds, closely allied to *Contigidae*, are little like them in outward appearance; they are all small birds, said to have the habits of the English Tit mice. All belong to Neo-Tropical regions, numbering nineteen genera and some eighty species. Many of them have brilliant patches of colour; *Pipra aureola*, for instance, has a flaring red head which, when the crest is erected looks like a flaming torch; others have golden heads or yellow. They live among trees n shrubs and feed on fruit, berries, seeds and also insects. Their note may be loud or whistling; one species at least, (*Chiroxiphia linearis*) has the credit of displaying itself, and another of the same genus (*caudata*) of holding a con-

cert, all listening while one sings. The females are generally dull green, or some other sombre hue. They make shallow nests of grass and tendrils which they hang from the forks of trees or shrubs, and lay eggs yellowish or reddish white, mottled or blotched with darker colour.

MANAKINS. (*Colonial*).—*Pipridae.*

†Yellow Manakin	*Piprites chlorion.*
Green ,,	,, *uniformis.*
Black ,,	*Xenopipo atronitens.*
Crested ,,	*Ceratopipra cornuta.*
Scarlet-crested Manakin (?)	,, *iracunda.*
Scarlet-headed ,,	*Pipra aureola.*
Golden-headed ,,	,, *auricapilla.*
White-capped ,,	,, *leucocilla.*
Crested ,,	,, *comata.*
Blue-rumped ,,	,, *serena.*
Tricolour & black ,,	,, *suavissima.*
†Spotted ,,	,, *gutturalis.*
†Short-tailed ,, (?)	,, *brachyura.*
*Cinnamon ,,	*Neopipo cinnamomea.*
Blue-backed, red-capped	*Chiroxiphia pareola.*
	,, *caudata.*
Back and White Manakin	*Manacus manacus.*
†Dusky Manakin (Heteropelma)	*Scotothorus wallacei.*
Earth-brown Manakin	,, *amazonum.*
Yellow-crested ,,	,, *igniceps.*
Great ,, (?)	*Schiffornis major.*
Yellow-headed ,, (?)	*Heterocercus flaviverte.*
Gold-fronted ,,	*Neopelma aurifrons.*

(*To be Continued.*)

Selection of Rubber Seed.

The conclusion is that large seeds furnish by far the best results, both as regards germination and as regards growth of the seedlings. One should, therefore, before planting seeds, go over them and selecting from them, count as inferior and throw out all which weigh less than five grammes.

—"The Gardens' Bulletin," Straits Settlements,
June 20, 1914.

Hints, Scientific and Practical.

The Conditions for Research.

It is only too well known that other countries have some years past distanced Britain in the field of research; that while Germany is sending her trained sons to all parts of the world, we scarcely even supply our own colonies. A writer in "The Monthly Journal of Science" said last year that "to a very great extent, both in the home kingdoms and the colonies, we find ourselves compelled to import that intellectual eminence which we refuse to cultivate in our midst Foreigners occupy professorial chairs in our colleges, they fill the posts of botanists and geologists in our colonial governments, they hold high positions in the respective staffs of the British Museum, of the Geological Survey of India, and of our exploring expeditions."

Now as these results cannot be owing to any inbred deficiency in the countrymen of Newton, Faraday, and Darwin, it behoves us to ask if our educational system is at fault, and if fair provision is made for those able and willing to make original research.

Numerous suggestions have been made regarding the endowment of research, but most of them are unpractical Those who imagine that the object will be gained by establishing adequate teacherships of science, seem to be too sanguine. The labour involved in the work of teaching, in the way of acquisition, preparation, and performance, is too great to permit the devotion of sufficient time and thought to the search after new truth. If it is desirable that new facts and principles be searched after, why should fit inquirers be put, either partly or wholly to other work? I know that many of our teachers have hitherto been at a great disadvantage;that managers of institutions have had a sharper eye on their prospects than on their internal arrangements: that they have thought of a college rather as a body of bricks than as productive of a body of learning; and that apparatus and assistants, though well enough in Berlin or Leipzig, are needless in prudent England. Yet the ideal professor is rather the head of a department than a mere speaker by the yard of so many lectures; a man with numerous hands in the shape of demonstrators

and assistants, themselves the possessors of well-trained brains; a director of work with all its apparatus freely supplied to him. Such a man adequately remunerated, may be safely left to his own tendencies. Contact with nature breeds the desire to know her better. In favourable conditions the teacher becomes the investigator, and while seeking after new truths builds up his own fame.

—"Nature," January 27, 1881.

The Goat as a Source of Milk

THERE are two special qualities possessed by goats' milk which alone should make it popular:—

1. The ease with which it is digested by children, and especially infants.

2. Its almost complete immunity from germs of tuberculosis.

With regard to the first point, the substitution of goats' for cows' milk has been instrumental in saving many young lives. The explanation of this superior digestibility is furnished on scientific grounds by at least two authorities. The late Dr Augustus Voelcker held that it was due to the fact that the cream globules were much smaller than in cows' milk, and in a more perfect state of emulsion. The explanation of Dr. Barbellion, a French medical authority, is that the curd of cows' milk forms a dense adhering mass which by agitation separates into clots that are but slightly soluble, but the curd of goats' milk forms very small, light flakes, which are soft, very pliable and very soluble, like those in the milk of the ass and in human milk. Samples of these latter as well as goats' milk were submitted to the action of digestive ferments and were found to be digested competely in 20 hours, whilst the same process applied to cows' milk showed only a very slight progress after 60 hours

So much has been written on the prevalence of tuberculosis amongst cows and the possibility of communicating the disease to the human subject through the milk that, when it is fully recognised how comparatively free from such germs goats' milk has been proved to be, this valuable quality should stimulate its use. In this connection

Sir William Broadbent may be quoted. In his address to students on the "Prevention of Consumption and other Forms of Tuberculosis," he said: "It is interesting to note that asses and goats do not suffer from tuberculosis, and to bear in mind that the shrewd physicians of past days used to order asses' and goats' milk for persons threatened with consumption."

To realise the difference between goats' and cows' milk one has only to return to the latter after a course of goats' milk. The difference is very much the same as when skimmed milk is substituted for whole milk. This superiority is not so noticeable when goats' milk is drunk by itself as when it is taken in tea or coffee, or used in milk puddings, custards and blanc-manges; the rich, creamy taste is then very marked.

—"The Journal of the Board of Agriculture,"
October, 1915.

8 Bordeaux Mixture as a Spray for Rubber Trees.

DURING investigations made last year by F. T. Brooks, M.A., and the writer of this article, it was necessary to carry out spraying experiments with Bordeaux mixture to determine if spraying methods were likely to be useful in the control of Pink Disease. Mechanical difficulties and climatic conditions in Malay render such methods useless except in special cases The experiments were conducted with spraying machines specially adapted for use on plantations in this country. The Bordeaux mixture was made up of the following:—12 lbs. Copper Sulphate, 8 lbs. Quicklime and 100 gallons of water.

The experiments were specially conducted to test the effect of Bordeaux mixture salts on the resulting rubber. The rubber was made up in sheet form so that as much of the copper salts as possible was retained. In July and August, 50 trees were sprayed once a week from the level of the upper tapping cut to a height of 25-30 feet above this level. Control plots were kept for purposes of comparison Excess of fluid was applied which ran down over the cuts, channel and spout. None of the rubber sheets from these trees were tacky by the end of November. From Septem-

ber 10 to November 12, the trees were treated as above, but the tapping cuts were deliberately sprayed.

Examination showed a plentiful deposit of blue copper salts on the spout and tapping cuts after the application. Only one sheet of rubber in the batch, manufactured on October 2nd. was considered to be tacky. This sheet was prepared from latex gathered on October 1st on which date spraying was done The tacky sheet was much folded together and the surfaces were so sticky as to be inseparable. The experiments stopped in November. All the rubber sheets were kept for several months in the laboratory, but there was no further development of tackiness though the presence of Copper salts in appreciable quantities was demonstrated by the Agricultural Chemist. It can now be stated, that there is little danger in using Bordeaux mixture as a spray against the attacks of fungi on rubber trees. If trees in bearing are to be sprayed with Bordeaux mixture they should be rested for two or three days after the spraying. This period would be quite sufficient to allow for accidents.

- The Agricultural Bulletin of the Federated Malay States, September, 1915.

The Manurial Situation and its Difficulties. Of the four important kinds of manurial materials (nitrogenous, phosphatic. potassic, and calcareous), there is only one the potassic, of which there will be a serious scarcity, and it seems almost certain that greater difficulty will arise from want of labour than from want of raw material.

It is probable that there will be sufficient supplies of nitrogenous manures. In normal times we export over three-fourths of our total production of sulphate of ammonia. Such export will now be restricted, as this and other fertilisers can only be exported under licence. Our total production of sulphate of ammonia exceeds 400,000 tons per annum, so that there should be sufficient of this valuable fertiliser available to meet even greatly increased consumption. It is probable that the price will be a little higher than in pre-war times owing to the enhanced price of sulphuric acid, and the increased cost of labour and

transport, but it is not likely that the price will be excessive.

An immense amount of potash is at present lost in liquid manure. It is not generally realised that liquid manure is far richer in potash than in any other manurial constituent. As a result of 35 analyses of liquid manure obtained from farms in the north-east of Scotland, the writer found that the percentage content of potash is, on the average, more than twice the percentage of nitrogen. There are, naturally, great variations in composition, and in exceptional cases the nitrogen was higher than the potash, but in nearly all cases the potash was higher than the nitrogen, and generally very much higher.

Most of the potash in the food of stock is excreted in the urine, and the liquid which drains away from dung heaps were saved and used as manure, it would largely do away with the necessity for the use of special potash manures, and would also supply much nitrogen to the soil. With potash at its present high price, the waste of liquid manure is almost criminal.

—" The Journal of the Board of Agriculture,"
(England), October, 1915.

The Demand for Molybdenum.

At the present time there is an exceptionally large demand for the so-called "special steels," that is to say, steels which are specially hardened. This class of steels is much used in connection with ornament work, and particularly for making machine tools the wear and tear of which in our large engineering works is just now abnormally high.

These "special steels" are made by the addition of various comparatively rare metals, such as tungsten, manganese, vanadium and molybdenum, to steel, and their importance may be gathered from the fact that in Germany all stocks of these metals are being commandeered by the government. In the United Kingdom molybdenum is at present in so great request that the ore is now selling at £540 per ton.

—" The Colonial Journal," July, 1915.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the year 1915. The corresponding figures for the two previous years, and the averages for the four years previous to that, are added for convenience of comparison.

Product.	*Average 1909-12.*	*1913.*	*1914.*	*1915.*
Sugar, tons ...	99,623	87,414	107,137	116,223
Rum, gallons ...	2,289,829	3,260,986	3,489,729	4,698,230
Molasses, casks ...	1,872	1,187	832	...
Cattle-food, tons ...	7,388	6,859	2,426	2,233
Cacao, cwts. ...	487	505	445	532
Citrate of Lime, cwts.	4	36	99	170
Coconuts, thousands	927	872	1,890	2,090
Copra, cwts. ...	1,282†	1,127	1,690	1,619
Coffee, cwts. ...	1,110	797	2,131	1,538
Kola-nuts, cwts. ...	24	1	4	17
Rice, tons ...	3,737	7,709	7,090	9,058
Ricemeal, tons ...	2,005	1,802	241	266
Cattle, head ..	983	965	1,172	649
Hides, No. ..	4,477	5,106	4,646	1,584
Pigs, No. ...	1,318	1,604	1,303	1,193
Sheep, head ...	76	40	141	12
Balata, cwts. ...	9,349	11,817	9,131	13,903
Charcoal, bags ...	73,950	62,321	67,450	58,424
Firewood, Wallaba, etc., tons ...	9,319	8,670	10,204	8,905
Gums, lbs. ...	4,764	2,237	886	...
Lumber, feet ...	259,837	517,819	254,772	225,453
Railway sleepers, No	5,280*	11,020	10,627	2,556
Rubber, cwts ...	17*	11	9	41
Shingles, thousands	2,437	2,645	1,806	2,214
Timber, cub. feet ...	254,093	437,111	212,418	113,861

* In year 1912 only.
† In years 1911 and 1912 only.

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Artesian Well Water for Rice Lands.

It has been well said that successful rice cultivation is a matter of water supply. It all depends upon what is understood by that phrase "water supply." Water is needed--water for germination, water for growth, water to regulate the temperature of the field, water for keeping down pests, water for carrying nutriment to the plants, water for killing out weeds and grass, plenty of water to keep the water fresh on the ground: but the phrase implies something more--complete control. The rice planter must know the right amount of water to use at any given period of the crop, he must know the right time to use it and how to apply it in the best manner. It should be the object of the grower to "apply only the amount of water which is most beneficial to the plants during the different stages of plant growth. Good economy calls for the use of only so much water as is necessary to make the best yields. It is not good economy to save water to the extent of injuring the crop. If too little or too much water is used, lower yields will be secured, due to stunted plants and small heads in the first case, and loss due to poor stooling or straight-head blight on some soils in the second."* Given this knowledge and control, it is undoubtedly true

*Texas Dept. of Agriculture Bulletin, No. 43.

that successful rice growing is a function of the water supply.

That irrigation might furnish the means of control and artesian wells the water supply, seem obvious corollaries to this proposition. In Texas two successive crops of rice can be grown with irrigation on very sandy loam soil, and four crops on the black clay. At D'Urban Park, in this colony, where the water from an artesian well is available, five crops, averaging 26.6 bags of 120 lbs. per acre, have been raised in 25 months. These facts indicate possibilities which must appeal to any man of affairs.

At the Experimental Fields of the Botanic Gardens, Georgetown, where the irrigation water is under complete control but is not supplied by an artesian well, the following interesting figures have been recorded:—

Water During Growth of Crop.

Year.	*Rain.*	*Irrigation.*	*Total Inches.*	*Lbs. Padi per acre.*
1909	24.83	26.12	50.95	4,524
1910	38.07	25.50	63.57	4,880
1911	33.71	24.40	58.11	3,270**
1912	16.04	27.80	43.84	4,956
1913	28.65	38.10	66.75	5.880
1914	18.53	32.90	51.43	6,199
1915	18.76	44.90	63.66	5,046
Means	25.51	31.39	56.90	4,966

On analysis these figures show that in the driest crop period (1912) a full normal crop of 2.2 tons of padi per acre was obtained with 27.8 acre-inches of irrigation water: in 1914 a maximum crop of 2¾ tons was got with 33 acre-inches of irrigation water. The monthly average in 1912 was 9 acre-inches, in 1914, 11 acre-inches. Except in abnormally dry seasons, 9 to 11 acre-inches of irrigation water per month of the period of active growth produces very satisfactory results. In fact, in normal years, 8 acre-inches per month would seem to be suffiicent for a full crop. Excessive water supply has resulted in reduced crops, and not necessarily in increased returns.

** Crop reduced owing to error of Assistant in regulating irrigation water.

In Texas the rice crop may reach 16 to 18 cwts. per acre, with an average of 11 cwts. In British Guiana the average yield has been 1¼ tons per acre. In North Essequebo, with good irrigation, the average yield over two crops per annum approximates to 3⅛ tons per acre—one crop of 20 bags of 140 lbs. each, and one crop of 30 bags. With controlled irrigation and drainage, the average yield of padi in this colony should not be less than 1½ tons of padi per acre per crop, and this quantity, in favourable situations, should reach 1¾ to 2 tons.

With so attractive a prospect, it is surely worth while to develop as much as possible our artesian well system. Many of the wells in the rice country of Texas supply from 500 to 2.000 (American) gallons of water per minute: the average is about 890 gallons per minute. This is, however, pumped water, for the surface of water in the wells is far below the ground level, or soon becomes so. The average output of the British Guiana wells is about 200 (American) gallons*** per minute without pumping, from a pipe standing some inches above ground Allowing 10 inches per month of total water, as the amount required, it is calculated that one of our wells giving an average flow of 300,000 gallons, per day, would supply 50 acres of rice ground for two full crops, and would amply make up for any deficit in the rainfall

*** One American Gallon ca. 0 83 Imperial Gallons.

Chlorine as a Water Purifier.

The liquid chlorine which is being used by the Germans to produce asphyxiating gas has another and a very useful quality It is a very good water purifier. Indeed, it was for use as such that it was first put up in steel cylinders, and it is conceivable that it was originally brought to the German front for this purpose and that the use of the gas in fighting was a later thought. It acts as a steriliser, and though not entirely effective, probably affords the best means of dealing with impure water when there is no time for more elaborate processes.

—" The Colonial Journal," October, 1915.

The Cultivation of Limes. III.

(*By Professor J. B. Harrison, C.M.G., M.A., Director, C. K. Bancroft, M.A., F.L.S., Assistant Director, Department of Science and Agriculture, and G. E. Bodkin, B.A., F.Z.S., Economic Biologist.*)

DISEASES in cultivated plants are usually classed under two heads, viz., (1) those which are due to the non-living environment, *i.e.*, soil, atmosphere and physical conditions. and (2) those brought about by living organisms, plants or animals. Lime trees cultivated in British Guiana are subject to diseases of both of the above classes. It should, however, be remembered that no one factor alone is sufficient to induce disease; hence damage which is commonly attributed to a fungus, bacillus, insect or other organism *is in reality primarily due to a combination of influences more especially to soil, atmospheric and cultural defects.* Neglect of the hygiene of the soil is the fruitful cause of plant diseases. The significance of predisposition to disease is, we fear, seldom sufficiently appreciated by the cultivator. For example, lime trees are particularly susceptible to unfavourable soil conditions; and there is little doubt that the disease known as "Mal-di-gomma," "collar rot" or "gummosis" is primarily induced by certain physical conditions existing around the base of the trees, although several authorities attribute the disease solely to the activity of a living organism.

DISEASES OF THE LIME TREE.

The diseases to which lime trees are subject in this colony are dealt with in detail in the following part of this article:—

(a.) *Diseases caused primarily by physical influences*:—

i. *Yellowing of leaves.* This is a disease induced by adverse soil conditions, *viz.*, either the physical texture of the soil or a deficiency of one or more of the essential elements of plant food, mineral constituents, or a deficient drainage. Limes growing on heavy clay land, such as occurs in many parts of the coast-lands of the colony, are

frequently affected in this way. Soils deficient in available nitrogen, potash or phosphates frequently give rise to the same condition, while deficient drainage is also a common cause. In places the chlorosis of the trees may be due to deficiency in readily available iron.

The remedies are obvious. Land should be carefully selected for planting; a light, well-drained soil is most suitable for lime cultivation. The application of 2lb. of superphosphate and 1 lb. of sulphate of potash per trees is frequently beneficial where the plants have developed a yellow and unhealthy appearance.

ii. "*Stag-head*" is a condition induced by exposure to constant winds. Sometimes it is caused by deficient drainage or tillage. Recommendations made in the first of this series of articles in regard to protection from wind should be carefully followed. "Stag-head" is, perhaps, one of the more important and frequent causes of non-productivity of the lime tree.

iii. *Citrus Knot*. Lime trees frequently show knots on the stem arising usually either at the base of a branch or in the interval between the points of origin of two branches. The knots arise as small protuberances and gradually increase in size until they may attain a diameter of 2 or 2½ inches. They are woody structures composed of short tracheids--resembling in appearance the cells present in "wound-wood." They are similar to the woody nodules occurring on Beech and other English forest trees, but differ in this respect that they cannot be readily removed by a knife, as the wood of each knot is fused with the wood of the branch on which it arises.

The cause of production of these knots is not clear. although recent work conducted in the United States attributes their origin to the action of a fungus, *Sphaeropsis tumefaciens*. All attempts made in the laboratories of this Department to isolate any organism from the wood of fresh knots have failed. Old knots whose wood has been exposed to the air for some days frequently show the presence of a *Diplodia*, which is clearly a saprophyte. The genus *Diplodia* is very closely allied to the genus *Sphaeropsis*

Similar excrescences, such as burrs and sphaeroblasts, are sometimes due to previous injury; at other times they are due to sudden exposure of the shoots to light through heavy pruning or by the felling of adjacent trees, the excrescences being in such cases the product of development of adventitious or dormant buds. As far as our observatons have gone in British Guiana "citrus knot" is usually associated with the presence of bird-vine (*Loranthus Theobromae.*)

It is doubtful whether knots are injurious to the trees or not. In some cases where a knot encircles a branch, the portion of the branch above the knot dies. The knots may be easily got rid of by pruning.

iv. *Gummosis* or 'mal-di-gomma.' This is a common disease of lime trees. It is also the most common and wide-spread disease of the orange.. First reported from the Azores as early as 1832, the disease is now known to be present in Southern Europe, the West Indies, United States, Hawaii, Australia and probably in all other regions where the orange or lime is grown.

The actual cause is unknown. It has been attributed by different authors to a fungus *Fusarium Limonii*, another fungus, *Agaricus Citri* a bacillus *B. gummi*, and to different physical influences. Our own observations have shown us that the disease is most prevalent on heavy clay land and is encouraged, if not directly caused, by certain adverse conditions existing around the base of the tree. Mulching or the heaping of earth around the collars of trees predisposes them to the disease, while the liming and the loosening of the soil at the base of trees enables them in many cases to resist the disease. It is significant of this that the disease was scarcely ever found in native Indian cultivations until mulching and moulding of the trees were introduced. Wounding is also a possible cause. We must, therefore, regard the disease, at any rate for the present, as a physiological one, arising from adverse soil conditions, defective drainage, mechanical injury or some such cause.

The disease occurs most commonly at the collar of a tree. It may extend some distance up the trunk or downwards along the roots. An exudation of gum first occurs. This

is followed by a brownish discoloration. Sometimes a distinct odour is present. Where the trunk is ringed the tree usually dies.

Careful cultivation, the removal of affected parts with a knife and the tarring of the exposed healthy wood, the removal of earth from around the base of the affected trees, and the application of lime to the land, are remedies for the disease. In some cases, too. the trunks are treated with 5% carbolic acid, after the affected parts have been removed.

(b.) *Diseases caused by plant organisms*:—

i. *Wither tip, Leaf spot or Anthracnose* attacks many citrus plants, including the lime. The disease is of fungus origin and is caused by *Colletotrichum glocosporioides.* It occurs on trees of all ages, from seedlings to mature trees The tips and edges of young leaves usually show the disease first. The leaves wither and die, and the disease spreads to the young stem, giving rise to "wither-tip." Defoliation of a tree may result in this way. Blossoms and young fruit may also be attacked, resulting in the trees becoming fruitless. Young fruits when attacked fall readily. When, however, the fruit is nearly full grown, it is usually not affected except through wounds made by careless handling.

Pruning and the removal and destruction of diseased parts help to keep the disease in check. Spraying with Bordeaux Mixture at intervals from the time the fruit is set until it is nearly mature, is a good preventive.

ii. *Sooty Mould.* This is due to a fungus, *Capnodium citricolum.* The leaves, stem and fruits become covered with a sooty coating. The leaves are prevented from performing their proper functions and the vitality of the tree is impaired.

The fungus is not parasitic. It lives on the honey-dew exuded by certain insects. The treatment, therefore, consists in getting rid of the insects. This is best done by spraying with a rosin wash.

iii. *Root Diseases.* Two have recently made their appearance among lime trees planted in the interior of the colony on cleared forest land. The symptoms of both diseases are almost identical. Affected trees may appear unhealthy for some time, but they usually show little or no indication of disease until death is imminent. The complete death of a plant usually occurs within a few days following on wilting of the younger parts above ground. In one case, *viz.*, the disease caused by *Fomes semitostus*, the affected roots bear strands of mycelium which are white when young and yellowish brown when old. In the other disease, *viz.*, the brown root disease, caused by *Hymenochaete noxia*, the tap-root and sometimes also a small portion at the collar of the plant above ground are covered by a brownish incrustation in which sand and small stones frequently accumulate.

Both fungi live on dead stumps of forest trees, from which they spread to the living roots of the lime trees. As many of these stumps as possible should be cleared before planting is commenced. When a tree is once affected there is no cure; but the disease can be arrested by trenching affected areas, removing all dead wood and burning it on the surface along with the roots of the affected trees. The areas should then be dug over and limed before supplying is done. In the case of the latter disease ('the brown root disease') trenching is not necessary, as the spread of this disease is not appreciable unless diseased and dead trees are allowed to remain in the ground for a long time.

iv. *Lichens* frequently occur on the trunks and leaves of the trees more particularly where they are closely planted These cause no direct injury, but where prevalent they prevent those parts from performing their proper functions. Pruning, thinning out and the use of strong Bordeaux Mixture are remedies.

v. *Bird-vine* (*Loranthus Theobromae*) frequently affects lime trees and may cause considerable damage on neglected cultivations. It should be kept under control by removing it from the trees at frequent intervals.

INSECT PESTS OF LIMES.

The lime plant when grown under favourable conditions of soil, cultivation, etc., is seldom seriously hindered by the attacks of any insect pest. When the leaves, branches and fruit of a plant are observed to be covered with several species of scale insects these may be taken as a sure indication of a general poor state of health. It is, therefore, a matter of prevention rather than cure; no amount of spraying will ever rid a tree of scale insects if that tree is grown in the wrong kind of soil or its proper cultivation neglected

As scale insects are among the worst and most persistent pests of limes, these may be considered first.

The Mussel Scale, (*Mytilaspis citricola*, Newm.) This insect appears particularly on the leaves, twigs and fruit of the plant. It is a mussel-shaped scale, brown or purplish in colour, tapering towards one end. It spreads rapidly, and if left unchecked, will speedily cause serious damage. It is best treated with Resin Compound made as follows:

Stock Solution	Resin	8 lbs.
	Ordinary Washing Soda . .	6 lbs.
	Rain Water	4 galls.

For use, dilute this solution to either 1 in 4 or 1 in 6 according to strength required.

To make this stock solution satisfactorily, the following points should be observed:—the resin should be crushed fine, and the soda dissolved first in the water (2 galls.) by heating. The resin is then gradually added, the solution being meanwhile stirred. Finally, the solution is well boiled and the rest of the water added.

The solution is best applied by means of a spraying machine Spraying is best performed in the early morning. A good pressure should be maintained in the machine so that the spray may be delivered in a very finely delivered condition (*i.e.* a mist-like effect should be obtained). In

this condition it will settle far more effectively on the leaves, etc. Care should be taken that all infected parts of the plant are reached. As soon as the leaves are observed to drip, spraying should cease.

The Orange Snow Scale, (*Chionaspis citri*, Comstock), is another common and pernicious pest. It infests the trunk and older branches of the tree, often completely enveloping these parts with a white, snow-like covering.

Spraying with the above-mentioned solution is effective, but in bad cases the mixture may be applied with a large brush, working it well in

Several other species of hard-bodied black or dark coloured scales are at times encountered. These may also be treated with Resin Wash.

Mealy Bug, (*Pseudococcus citri*, Risso), is at times, troublesome, especially on the fruits and leaves. It appears as small, rounded, soft-bodied insects, clustering together and covered with white powder. Spraying in the manner previously described with Kerosene Emulsion will eradicate this pest.

Kerosene Emulsion is best prepared as follows:

Stock Solution	Kerosene	2 galls.
	Rain Water	1 gall.
	Soap (Ordinary yellow or soft soap) .. .	½ lb

For use, 6 gallons of water are added.

The stock solution is best prepared by first dissolving the soap in the water by heat and adding the kerosene while the mixture is still hot. The mixture should be kept well stirred during use.

Coushi Ants, (*Atta cephalotes*, L.), are often troublesome, especially in newly planted areas. They should be traced to their nest, which should be destroyed. Provided the soil is not too sandy, one of the best methods of destruction is 'puddling.' If this is not possible, all the exit holes to the nest should be thoroughly closed up with the exception of

several large ones towards the centre of the nest. Into these holes several pints of carbon bisulphide are poured, and the holes securely closed to prevent the escape of the fumes.

With small and medium sized nests this answers well, but the very large nests are very difficult to destroy. Pumping the fumes of sulphur into the nest is also effective with the smaller nests.

If the ants are persistently annoyed with any of the above methods they will eventually migrate to another locality

In some cases the nest may be isolated from the cultivation by means of a trench always kept well filled with water and free from weeds, for these ants are exceedingly clever and will speedily take advantage of any means of crossing the water.

Caterpillars or ' worms ' which eventually turn into butterflies, are sometimes found feeding on the foliage of the lime tree. A common caterpillar is that of the butterfly *Papilio anchisiades*, Esp. These caterpillars feed exclusively at night; during the daytime they may be found clustered together usually at the base of the tree. This habit makes their destruction an easy matter.

(To be Continued.)

Conditions for Agricultural Research.

'Agricultural research deals with subject-matter profoundly complex, bafflingly difficult, and because of this demands researchers of the very finest quality—men with "the spirit," men free to work in an atmosphere cleared of the hampering influences of compulsory advertisement by result,—for these latter are often the outcome of luck, and in no case can they be produced to order—free from the compulsion to provide passable annual reports for the scrutiny of an official tribunal, free from the worry as to the wherewithal to live: in other words, men provided with a living wage.

-A. D. Hall, M.A., F.R.S., quoted in "The Agricultural Bulletin of the Federated Malay States," September, 1915.

Experiments with Rice, Coconuts, Rubber, Coffee and Cacao: Crops of 1914.

By Prof. J. B. Harrison C.M.G., M.A., Director, C. K. Bancroft, M.A., F.L.S., Assistant Director, and R. Ward, Agricultural Superintendent, Department of Science and Agriculture

RICE.

The return of the area under rice cultivation in the colony as received from the District Commissaries was 47,037 acres, an increase of 17,454 acres over that of the preceding year; but as two crops were reaped in the year in certain districts the actual area of rice reaped was 53,661 acres. In 1898 the acreage returned by cultivators as being under rice was about 6,000, and the increase in the crop of rice between 1899 and 1915 represents about 32,000 tons of cleaned rice per annum of a probable value of $2,000.000. Considering that the industry is pursued mainly by small farmers, its rapidity of development has been phenomenal. This has been mainly due to the East Indian settlers, but the black people of the colony are also entering with some enthusiasm into the industry.

The variety of rice cultivated generally in the colony is the Demerara Creole, a long-grained variety, which has probably arisen locally by unconscious selection.

YIELDS OF PADI.

The yield of padi obtained per acre in 1914 was 19.7 bags of 140 lbs. each to the bag, equivalent to 24.6 cwt. per acre, the total yield being 1,060,292 bags. The figures show a decrease of .7 bags per acre compared with those of the 1913 crop.

The following table gives the average of padi per acre in the colony from 1898 to 1914;—

	Average yield of padi: cwt. per acre.
1898-1902	21.5
1903-1907	23.8
1908-1911	25.3
1911-1914	25.2
Mean	23.9

The exports of rice and rice-meal for 1914-15 were respectively 7,090 tons and 241 tons.

EXPERIMENTS WITH VARIETIES.

The experiments with rice varieties were continued at the Experimental Fields. As in the previous year varieties of proved value were planted in the North Field on large scale trials in duplicate ½ acre plots. The yields obtained were as follows:—

Selected Varieties.	*Bags of 140lbs., per acre.*
No. 75	36.3
Creole	36.2
H 6	34.6
Strains.	
No. 75 strain 7	39.0
No. 75 strain 6	37.9
H 6 strain 1	37.3

The crop reaped was not as good as that of the previous year, but was considerably above the average.

IMPORTED VARIETIES.

Upwards of 250 varieties have now been imported from foreign countries into the colony by the Department for the purpose of experimental cultivation. Of these, two, No. 75 and H 6, have given better yields than the Creole rice under trials extending over a period of ten years, while three strains specially selected from these two varieties have yielded still better results than the parent rices from which they were obtained. Taking the series of ten years, 1905-1914 inclusive, during which trials with the three varieties, Creole, No. 75, and H 6, have lasted, the mean results have been as follows;—

Kind of Rice.		*Bags of 140lbs., per acre.*		*Creole taken as 100.*
H 6	..	33.47	..	104.1
No. 75	..	32.86	..	102.2
Creole	..	32.15	..	100.

One of the most notable features brought out by the trials is the increase in yield of the Creole rice as a result of repeated selection of seed.

The padi reaped from this crop totalled 28,764 lbs. or nearly 13 tons. By means of a rigid seed selection annually the padi yielded by the rice crop is rendered 99% pure. It is proposed to distribute this padi as has been done in previous years to ricegrowers in the colony for the planting of the 1915 crop. The amount available should be sufficient to plant up over 500 acres.

The duplicate and quadruplicate comparative trials of certain varieties and strains on 1/16 acre plots gave the following results:—

Variety of Strain.			*Bags of 140 lbs., per acre.*
No. 75, Strain 1	..	..	34.10
No. 75, Strain 4	..	..	44.77
No. 75, Strain 8	..	..	39.57
No. 75 x Honduras	..	..	18.20
No 75 x Carolina Golden Grain		..	22.91
Creole—selected as pure to type		..	37.86

HYBRIDISATION EXPERIMENTS.

The work of hybridising rice has been continued. It is not possible to express any opinion as to its probable value. The manner in which the flower is adapted to self-fertilisation by the dehiscing of the anthers immediately it opens renders artificial hybridisation very difficult. It has accordingly been found that most of the supposed hybrids retain, in future generations, all of the characters of the female parent and must, therefore, be regarded as 'selfs.'

MANURIAL EXPERIMENTS.

The manurial experiments with rices in the North Field have continued. Twenty-six plots, ⅛ acre each, were cross-

dressed with sulphate of ammonia at the rate of 100 lbs. per acre, and twenty-six plots, their duplicates, did not receive any nitrogenous manuring. The results obtained in this experiment showed that the mean return from the manured plots was 36.31 bags of 140 lbs. per acre, while the mean return from the unmanured plots was 37.13 bags. From these and from the results of experiments on manuring of rice in previous years it is clear that in the period during which the rice land is in fallow an accumulation of available nitrogen sufficient for the needs of the crop takes place. The addition of nitrogen in the form of artificial manure serves only to increase the luxuriance of the vegetative growth, thus causing the plants to be early laid.

RICE IRRIGATION WITH ARTESIAN WATER.

By direction of His Excellency the Governor trials were commenced in September, 1913, of growing rice under irrigation with artesian water. By growing the crops continuously it is anticipated that five crops will be obtained in two years. The results of this highly interesting trial will be published on its completion.

COCONUTS.

The area planted with coconut palms in the colony has been slowly increasing for some years, but during recent years there has been much greater activity in coconut planting and the continued extension of the industry may be expected.

The coconut palms growing in the colony are scattered, being owned chiefly by small growers; but there are a few fair-sized coconut estates and the large proprietor is paying increasing attention to the cultivation of the palm. On one estate, where coconut planting is being carried out on a large scale, upwards of 50,000 trees have been planted, while another property possesses 20,000 trees. The acreage in the colony under cultivation in coconuts in 1914-1915 was 15,894, an increase of 1,717 acres over that of the previous year. The gradual extension of the industry is shown in the following table:—

Year.			*No. of acres planted.*
1904-05	..	..	5,140 acres.
1905-06	..	..	6,560 „
1906-07	..	..	6,700 „
1907-08	..	..	6,828 „
1908-09	..	..	8,315 „
1909-10	..	..	9,466 „
1910-11	..	..	9,761 „
1911-12	..	..	12,236 „
1912-13	..	..	13,698 „
1913-14	..	..	14,177 „
1914-15	..	..	15,894 „

A very large proportion of the acreage is still young and has not yet come into bearing. The export of coconuts is small in comparison with the acreage under cultivation both for the above reason and because the major portion of the nuts is utilised in the colony in the manufacture of coconut oil and cattle food. There is a large consumption of coconut oil especially among the East Indian section of the community and the locally prepared product has gradually replaced the imported kinds of coconut oil.

EXPORT OF NUTS.

The export of coconuts during 1914-15 was 1,890,000 as against 872,000 in the previous year. The following table shows the average annual exports for quinquennial periods since 1892:—

Periods.			*Average Annual Exports.*
1892-6	..	..	80,374 nuts.
1897-01	..	..	21,892 „
1902-06	..	..	187,305 „
1907-11	..	..	526,901 „
1912-14	(3 years only)	..	1,427,644 „

A small quantity of copra was made in the colony during the year, the export being 1,690 cwts.

Better attention is being paid to the proper spacing of the plants, but the necessity for proper drainage is frequently overlooked.

YIELD OF NUTS.

Most of the varieties raised at the Botanic Gardens from imported and from selected local nuts are now bearing and the seed is being distributed for planting purposes. Five hundred and sixty-nine nuts were distributed during the year, the number being made up as follows:—

Origin of Trees.	No. of Nuts Distributed.
From trees grown from Singapore nuts ..	187
" " " " Trinidad nuts ..	56
" " " " Tobago nuts ..	207
" " " " selected local nuts	119
Total ..	569

The following returns giving the average number of nuts per tree occurring on some of the trees growing at the Experimental Fields, Botanic Gardens, are of interest:—

Origin of Trees.	No. of Trees.	Average No. of Nuts per Tree
Trees raised from Singapore nuts ..	7	123
Trees raised from selected local nuts ..	5	91
Trees raised from Tobago nuts ..	4	82
Trees raised from Trinidad nuts ..	3	56

RUBBER.

There are now 4,962 acres cultivated in this product in the colony, an increase of 743 acres over the previous year. It consists almost entirely of the Para Rubber (*Hevea brasiliensis*). By far the greater proportion of the trees have not yet reached maturity; it is anticipated, however, that tapping operations will be commenced on a fairly extensive scale in 1916.

	Cured Cacao : increase on not manured Plots, lbs. per acre.	Per cent.
Heavily mulched	72	12.8
Superphosphate and sulphate of potash	51	18.1

whilst during the second of the years the effects were:—

Heavily mulched	48	12.8
Superphosphate and sulphate of potash...	40	9.2

the after effects of the mulching proving to be the more lasting

The retarding effects as regards production of fruit of the active nitrogenous manuring noticed during the years of its application ceased to be appreciable in the second year (1911.)

SOIL CONSTITUENTS.

The following were the determinations of the soil constituents usually considered as of importance in the soil used for the manurial trials during the past 12 years:—

	Per Cent. of Dried Soil.	Lbs. per Acre to the Depth of 18 Inches.
Nitrogen	·122	8,320
Phosphoric anhydride soluble in boiling hydrochloric acid ..	·065	3,900
Phosphoric anhydride soluble in 1 per cent citric acid ...	·0025	150
Potash soluble in boiling hydrochloric acid	·502	30,120
Potash soluble in 1 per cent citric acid	·0052	312
Lime soluble in boiling hydrochloric acid	·248	14,880
Lime soluble in 1 per cent citric acid	·0390	2,340

The total yields of the plots during the six crops of the second series (1909-1914) of the trials have been:—

	Cured Cacao, lbs. per Acre.
No manure	6,952 ± 226
Heavy mulching	8,868 ± 324
Sulphate of ammonia	6,632 ± 453
Superphosphate & sulphate of potash	8,878 ± 519
Sulphate of ammonia and superphosphate	7,729 ± 563
Sulphate of ammonia and sulphate of potash	7,339 ± 701
Sulphate of ammonia, Superphosphate, Sulphate of potash	8,129 ± 393

The indicated maximum and minimum gains in the not manured plots as deduced from consideration of the probable errors were:—

	Minimum.	*Maximum.*
Yields of not matured Plots for comparison*	7,178	6,726
	per cent.	*per cent.*
Mulching	19·0	36·6
Sulphate of ammonia	Nil	5 3
Superphosphate & sulphate of potash	16·4	39·7
Sulphate of ammonia and super phosphate	Nil	23 3
Sulphate of ammonia & sulphate of potash	Nil	19 5
Sulphate of ammonia, Superphosphate, Sulphate of potash	7·8	26 7

CONCLUSIONS.

This very clearly indicates that the soil contains a supply of available nitrogen sufficient for the requirements of cacao under the climatic and meteorological conditions existent at Onderneeming, that the proportions of readily available phosphates and potash present are not equal to the requirements of the cacao, that of these it is probably

the phosphates which are deficient, but to enable phosphatic applications to exert their effects, some addition of readily available potash is requisite. Applications of lime to the land have not exerted any beneficial action on the producing powers of the cacao trees.

The sole objection to the use of heavy mulchings is the cost. Up to the present the value of the additional yield of cacao has not sufficed to cover the cost of the mulching to which it is due; trials in future will be made to combine the increases due to manurings of superphosphate and sulphate of potash with those produced by heavy mulching.

SHADE.

Between November, 1900, and May, 1902, the shade-trees on the cacao fields were largely removed. On an area of about two acres of the southern cacao field the shade trees were not cut out. At the same time the methods of cultivation were changed and instead of the haphazard want of system that was in force prior to the cacao fields coming under the control of the Agricultural Department the fields have since been carefully cultivated, the trees pruned, and a persistent look out kept for pests of various sorts. Under these conditions the returns have greatly increased. The yields steadily increased from a mean annual yield of 1,064 lbs. during the five years prior to the thinning of the cacao trees; and during the past six years the crop has been at the following rates:--

	Cured Cacao. *lbs.*
1909	4,774
1910	5,582
1911	4,970
1912	4,451
1913	4,945
1914	4,548
Mean ..	4,878

CAUSES OF THE INCREASE.

The mean annual increase of 3,800 lbs. of cured cacao has been due to the three factors of lessening the shade, adequate tillage and care of the cacao trees, and improved drainage.

EFFECTS OF REDUCTION OF SHADE.

The yields having approached a fair degree of constancy—the falling-off in 1912 being due to the drought of 1911-1912—a commencement was made in January, 1913, to determine the results due to the lessening of the shade as apart from the other improvements. This is being done by recording the yields of cacao from the area on which the shade-trees were not thinned out, and from the adjacent parts of the cacao field on which the shade-trees had been largely reduced Four hundred and fourteen cacao trees are growing on the former and 586 on the latter.

The soil of this field is a much lighter one than is that of the present manurial experiment field. It is a clay loam and the mean composition of its soil and the quantities of the principal constituents of plant food in it to a depth of 18 inches is shown by the following anaylsis and statement:—

1.	Organic matters and combined water ..	8.44
	Quartz sand	38.25
	Clay and insoluble silicates ..	34.44
	Iron peroxide	4.07
	Alumina	12.51
	Manganese oxide	.09
4.	Calcium oxide (lime)	.24
	Magnesium oxide	.77
2	Potassium oxide	.53
	Sodium oxide	.50
	Sulphuric anhydride	.07
3.	Phosphoric anhydride	.09
		100.00

1.	Contains nitrogen	.152
2.	Soluble in one per cent. citric acid ..	.0070
3.	,, ,, ,, ,, ,, ,, ,, ..	.0042
4.	,, ,, ,, ,, ,, ,, ,, ..	.0407

STATEMENT.

Pounds per acre to a depth of 18 inches.

Nitrogen	9,120
Phosphoric anhydride soluble in boiling hydrochloric acid	5,400
Phosphoric anhydride soluble in 1 per cent. citric acid	252
Potash soluble in boiling hydrochloric acid	31,800
Potash soluble in 1 per cent. citric acid	420
Lime soluble in boiling hydrochloric acid	14,400
Lime soluble in 1 per cent. citric acid ..	2,442

The returns from the heavily shaded and the lightly shaded areas were at the following rates:—

	Per acre of 300 Trees.					
	Number of Pods			*Pounds of wet Cacao.*		
	1913.	*1914.*	*Mean.*	*1913.*	*1914.*	*Mean*
Heavily shaded	5,889	3,950	4,920	1,203	747	975
Very lightly shaded ...	9,546	8,870	9,208	1,823	1,522	1,672

The mean yield from the very lightly shaded area was at the rate per acre of 4,288 pods and 697 lbs. of pulp, equivalent in round figures to 2¼ cwt. of cured cacao, in excess of that from the heavily shaded part.

The mean annual increase of cured cacao per acre from 1910 to 1914 over that for 1897 to 1900 has been, in round figures, 3,800 lbs. This was the increased product of 3,186 trees of which 413 were heavily shaded.

If the 413 trees had not been shaded the increased yield would have been 4,150 in round figures, equal to 3½ cwt. per acre of 300 bearing trees.

These details indicate that the increased yields are probably due to the various treatments in the following proportions:—

	Dry Cacao per acre.
To lessening of shade	$2\frac{1}{4}$ cwts.
To improvements in cultivation and drainage	$1\frac{1}{4}$ "
	$3\frac{1}{2}$ cwts. per acre.

CONDITIONS FOR SUCCESSFUL CULTIVATION.

The experiments commenced in 1900 indicate that in British Guiana under conditions similar to those existent at Onderneeming farm, the methods of cultivation precedent to the successful growth of cacao are:—

1. The reduction of "shade" to the lowest amount compatible with due protection from wind.

2. Deep and efficient drainage, certainly not less than from 3 to 4 feet.

3. Annually forking the land between the trees in such a manner as not to injure their roots more than is absolutely unavoidable, whilst effectually loosening the soil for aeration and drainage, and thus constantly adding to the depth of tilled surface soil and the feeding area available for the roots of the trees. To do this requires the services of skilled forkers working under strict supervision.

4. Mulching the soil, but only so far as can be done at a low cost per acre; such cost not exceeding, say, $6.

5 Manuring the trees with a mixture of superphosphate of lime and sulphate of potash. The cost of such application should not exceed $4 per acre.

The Birds of British Guiana.

(By Charles B. Dawson, S.J., M.A., Oxon.)

III.

THRUSHES.

The common Thrush of the colony, "the Grey-breasted Thrush," as it is called (*Merula phaeopygia*) resembles the common English thrush (*Turdus musicus*) in form and habits and may be taken as a type. It is, however, slightly larger and has a grey-brown breast instead of a spotted one. Scientifically it is more nearly allied to the English Blackbird (*Merula merula*).

This large family belongs chiefly to the Old World, for of the one hundred genera and a thousand and more species (1,093) only ten genera and some hundred and thirty species belong to the New. Thrushes feed on insects, worms, and molluscs, as also fruit. Some of them will batter snail-shells to pieces on a stone with great vigour. They build cup-like nests, sometimes lined with clay, and lay bluish or greenish eggs, variously spotted or mottled with black or brown.

With some exceptions, they are sombre-coloured birds: browns, blacks, and greys, wth markings of red, buff or white, being the prevailing tints; the breast is often mottled or spotted, our colony thrush having a spotted breast when young, but the spots fade with age. Many of them compensate for their homely appearance by their melodious voices: the Nightingale and the common thrush of England and Europe generally, being the most wonderful songsters of all the feathered races. Many of them are migratory.

Babbling Thrushes or *Babblers,* are an ill-defined group closely allied to Thrushes. They feed among dry leaves and frequent forests or marshy places. Many of them chatter or chuckle and have thus given a name to the whole family. Like thrushes, they are generally of sombre hue, the sexes being generally alike. There are

fifteen genera, comprising some eighty species, almost equally divided between the Old and New Worlds.

THRUSHES—(Colonial). *Turdidae.*

Common Thrush (Grey-breasted)	*Merula phaeopygia.*
Bright-headed Thrush	,, *leucops.*
*†Bare-eyed ,,	,, *gymnophthalmus.*
Dusky ,,	,, *ignobilis.*
Mouse-like ,,	,, *murina.*
Smoky ,,	,, *fumigata.*
White-vented ,,	,, *albiventer.*
,, (Mt. Roraima)	,, *roraimae.*
†Yellow-legged ,,	*Platycichla flavipes.*
Grey-marked ,, (?)	,, *polionota.*
Red Vine ,, (?)	*Turdampelis gularis.*

BABBLERS—(Colonial) *Mimidae.*

Savannah Babbling Thrush	*Mimus gilvus.*
Black-headed Babbling Thrush	*Donacobius atricapillus.*
Brown Wood-Thrush	*Hylocichla fuscescens.*
Grey-cheeked Wood-Thrush	,, *aliciae.*
Red-brown ,, ,,	,, *ustulata.*

WRENS.

The familiar English "Jenny Wren," *Troglodytes parvulus,* is well approximated in this colony by the even more familiar "God-bird," *Troglodytes musculus.* The family, numbering twenty genera with some two hundred and fifty species, are nearly all inhabitants of these Neotropical regions, hardly twenty species belonging to the Old World. The colour of these small birds is generally reddish brown, with spots or markings of chestnut, grey, orange or black; the primaries and rectrices being often barred with darker colour. The note is shrill and warbling, sometimes developing into a song as in the case of our common God-bird; while the 'music-wren' or 'quadrille-bird' whistles the opening bars of a valse or quadrille in flute-like tones, surprisingly loud for the size of the bird.

Wrens build large, rough nests of ferns, grass, moss, or leaves; sometimes domed, hence their name, *Troglodytidae*, *i.e.*, cover dwellers. The eggs, sometimes to the number of nine, are generally white, sometimes speckled or freckled with red.

WRENS—(Colonial).	*Troglodytidae.*
Common Wren or God-bird	*Troglodytes musculus.*
* „ (mouse-like)	„ *clarus.*
Red Wren	„ *rufulus.*
*Grey, black-necked Wren	*Helcodytes griseus.*
†Smaller Wren (Sun-dweller)	„ *minor.*
Smaller Red Wren	„ *gularis.*
†Sprightly Bush-Wren	*Thryophilus leucotis.*
*White-breasted „	„ *albipectus.*
Black-faced „	*Thryothorus coraya.*
Rust-coloured or Song Wren	„ *musicus.*
*†Golden-red Wren	„ *ridgwayi.*
* „ „ (Orange-breasted)	„ *rutilus.*
†Seed-bush Wren	*Cistothorus alticola.*
†Bright-ticted Wren	*Henicorhina leucosticta.*
Music-Wren or Quadrille Bird	*Leucolepia musica.*
Banded Wren	*Microcerculus bambla.*
*†Red-brown Wren	„ *ustulatus.*

WARBLERS.

Under the general title of *American Warblers* are included a large family of twenty-five genera and two hundred and thirty species of small, shy, restless birds, all peculiar to the New World. They seek their food, consisting of insects, spiders, worms, molluscs, with occasional fruits and seeds, upon the ground or about the trunks of trees. Olive-greens or greys, browns, and yellows, with markings or bands of white, black or orange, are the prevailing tints. Some are like titmice in their habits, others like tree-creepers, others again like fly-catchers. *Siurus* will wade into the water and has thus acquired the name of 'water-thrush.' The ordinary note is a chirrup or

whistle, but some, such as the above mentioned, *Basileuterus*, and *Setophaga*, have a sweet, sustained song. The cup-shaped nests are made of grass, leaves, moss, and feathers; and the eggs, from two to six, may be creamy or greenish with markings of brown or black. The golden warbler is migratory and nests in North America.

Fly-catchers. These birds belong to an Old World family including no less than six hundred species; three genera with ten species, however, belong to the New World, and one single species represents the family in this colony, though many other birds have their habits and manners, notably, the grey-headed Tyrant-bird. They are adepts at catching flies on the wing, as their name implies.

Wag-tails and *Pipits.* These birds form one family belonging also to the Old World, but of the one hundred and ten species of which it is composed, ten are found in the New, and one representative in this colony. Wagtails, whose prevailing colours are black and white, or grey and white, or yellow, seek their food of insects, by wading in shallow water, and continually "wag" their tails as they go, hence their name. Pipits prefer open places with low bushes and weedy herbage. They are usually brown with dark streaks or white. Some of them have a lark-like song. Wagtails build their grassy nests on rocks in holes; pupits, on the ground.

WARBLERS—(Colonial.) *Mniotiltidae.*

Golden Warbler	*Dendroeca aestiva.*
†Wading Warbler (?)	*Siurus noveboracensis.*
†Ground Warbler (Yellow-vented)	*Chamaethlypis aequinoctialis.*
†Tanagrine Warbler (Rose-vented)	*Granatellus pelzelni.*
†Fire-red Moth-eating Warbler	*Setophaga ruticilla.*
†Fly-eating black-throated Warbler	*Myioborus verticalis.*
†Chestnut-capped Warbler	„ *castaneicapillus,*

†Roraima King Warbler (Mt. Roraima)	*Basileuterus roraimae.*
†Olive King Warbler	„ *olivascens.*
†White-vented Wood-Warbler	„ *mesoleucus.*
†Double-banded Wood-Warbler (Olive-yellow)	„ *bivittatus.*
†Golden-capped Wood-Warbler	„ *auricapillus.*

Motacillidae.

Red Pipit	*Anthus rufus.*

Muscicapidae.

Grey Gnat-Fly-catcher	*Polioptila Buffoni.*

GREENLETS.

Greenlets or *Vireos* are, as the name implies, small, greenish birds. They form a distinct family with six genera and more than a hundred species, all peculiar to the New World. Some ornithologists place them next to the Shrikes, others near the Thrushes. They probably have affinities to both. Olives, greens, and greys above, and grey, whitish and yellow below, are the prevailing tints; some have caps of black, brown, red, or ash. They are active and fearless birds, creeping about trees or hanging from the twigs like Titmice. Some have loud, melodious voices. developing into a song. They make beautiful nests woven of grass, leaves and cotton, adorned with lichens, and suspended from the fork of trees. The eggs, four in number, are white, usually spotted with brown, black or purple They feed on insects, seeds and berries; and are generally seen in pairs. The red-eyed vireo migrates north, even as far as Greenland, and has been reported as an accidental visitor to England.

VIREOS or GREENLETS—(Colonial). *Vireonidae.*

Black-whiskered Vireo	*Vireo calidris.*
Red-eyed „	„ *olivaceus.*
Nimble „ (?)	„ *chivi.*
†Yellow-throated „	*Pachysilvia thoracica.*
†Brown-faced Vireo (moss-taking)	„ *muscicapina.*
Olive-yellow Vireo	„ *sclateri.*

†*Brown-capped Vireo		*Pachysilvia bruneiceps.*
†Red-fronted „	(?)	„ *ferrugineifrons.*
*†Green-fronted „		„ *luteifrons.*
†Crook-beaked „		*Cyclorhis guianensis.*

MOCKING BIRDS.

These birds derive their name from the powers of mimicing which several species possess. They are not to be confounded with the true Mocking Bird of North America (*Mimus polyglottus*) or the Cat-bird of Canada, etc., (*Galeoscoptes carolinensis*) which are "babblers." They have affinities to starlings and finches. Some of them, such as the Caduri, the Corn-bird (or Lazy-bird) and the Troupials, have beautiful songs and make good cage-birds. Some are entirely glossy-black; others have patches or markings of bright yellow orange, or scarlet. The beak is generally long and sharp and, in the Cassiques, widens into a frontal shield. The legs are generally stout, the feet powerful. Bunyas and Mocking Birds live in communities and weave long, bottle-like nests, and hence are called Hang-nests. They choose high, spiny trees, or such as are infested with marabuntas or ants. Plantain-birds also build long, woven nests, but they are solitaries. *Quiscalinae* or "Boat-tails" carry their tails with the outer feathers uppermost giving the appearance of a rudder. *Cassidix* and *Molothrus* deposit their eggs in the nests of other birds. *Leistes*, like the skylark, frequents low-lying land; others are chiefly forest-dwellers. They feed on seeds and berries, insects, and fruit. Their note is loud, flute-like, and shrill, developing in some cases, as already stated, into a song. The eggs, four in number, may be blue with black spots, or whitish with spots and blots of brown and purple. In size and form they are generally similar to the starling, but *Cassidix* and *Ostinops* are as large as a crow. They all belong to the New World and number thirty-three genera with eighty-five species.

Mocking Birds—(Colonial.) *Icteridae.*

Black Bunya Hang-nest)	*Ostinops decumanus.*
Green „ „	„ *viridis.*
Yelow-backed Mocking	

Bird (cacicus)	*Cassicus persicus.*
Crimson-backed Mocking Bird	" *affinis.*
White-beaked Mocking Bird	" *albirostris.*
Great Rice Bird	*Dolichonyx* (*Cassidix*) *oryzivorus.*
Common Rice Bird (Lazy-bird)	*Molothrus atronitens.*
†Yellow-tufted Cassique (im Thurn's)	*Agelaeus imthurni.*
Yellow-headed Reed bird	" *icterocephalus.*
Brown " " (?)	" *frontalis.*
American Redbreast	*Leistes guianensis.*
American Meadow Lark	*Sturnella magna.*
(?)	" *meridionalis.*
*Black Mocking Bird	*Gymnostax melanicterus.*
Caduri	*Icterus chrysocephalus.*
*Black Plantain Bird	" *cayanensis.*
Yellow " "	" *xanthornus.*
Orange-breasted or Common Troupial	" *vulgaris.*
Yellow-crested Troupial	" *crotonotus.*
*†Tanager Starling	*Lampropsar tanagrinus.*
†Guiana Rudder-tail (or Boat-bill Black-bird)	*Holoquiscalus lugubris.*

TANAGERS.

Tanagers or *Sackies,* as they are locally called, form a large family of New World fruit-eating birds, of which there are twenty-five genera, including some four hundred and thirty species. They are nearly all small birds, *Saltator,* the largest, being the size of a thrush, and *Euphonia nigricollis* only three inches from the extremities of bill and tail. Some of them, and in particular the *Calospiza,* are very beautiful, disporting themselves in all the colours of the rainbow. The sexes are generally alike, though the females may be less brilliant; in a few cases dimorphism prevails as in the Louis D'Or, where the female is a dull green, and in the Black Tanager, the female being a dull red. Many have melodious voices, and in particular the genus rightly named *Euphonia.*

Tanagers are closely allied to the Finches; *Pitylus,* formerly placed among these birds being now regarded as a

finch. They have, however, longer beaks and only take seed occasionally, fruit being their staple food. The lower mandible of *Rhamphocoelus* is modified into the form of a small scoop; in *Euphonia* and others the beak is almost swallow-like. In *Procnias viridis* (or *tersa*) this is so much the case, that a separate family has recently been formed. *Procniatidae,* of which it is the sole representative. The nests are shallow and composed of grass, roots, etc., lined with hair or down. The eggs, like the plumage, are very varied, being white, greenish, bluish, grey, or rich brown, and generally mottled, freckled blotched, lined or scrawled with brown, lilac, purple, red, or black. Some of the species have crests. Many of them are easily tamed. sing pleasantly, and become interesting pets.

TANAGERS—(Colonial). *Tanagridae.*

†Roraima Yellow Singing Tanager	*Chlorophonia roraimae.*
Black-throated Singing Tanager (minuta.)	*Euphonia nigricollis.*
Yellow-marked Singing Tanager (?)	,, *chlorotica.*
*Golden-vented Singing Tanager	,, *xanthogaster.*
*(Purple-breasted)	,, *finschi.*
Olive Green Singing Tanager (?)	*olivacea.*
Louis D'Or Singing Tanager (blue and yellow)	*violacea.*
The Singing Tanager (?)	*lichtensteini.*
*Red-vented Singing Tanager	*rufiventris.*
†Black-cheeked Singing Tanager (Buck-town-Sackie)	,, *cayensis.*
†Steel-blue yellow-tufted Singing Tanager	,, *plumbea.*
†Blue-veiled Velvet Tanager	*Tanagrella velia.*
Paradise or Rainbow Tanager (*Calliste tatao*)	*Colospiza paradisea.*
Blue-headed Tanager	,, *cyanocephala (festiva.)*

Speckled Tanager	*Calospiza punctata.*
Spotted "	" *guttata.*
*Golden-yellow-vented Tanager	" *xanthogastra*
†Verdant Tanager (?)	" *virescens.*
Golden "	" *cayana.*
Yellow-breasted Tanager	" *flava.*
Brown-headed " (round-headed)	" *gyroca.*
Yellow-vented Tanager (Butterfly-wing)	" *flaviventris.*
Black-banded Tanager	" *nigricincta.*
Black and Green-grey Tanager	" *whitleyi.*
Golden Tanager	" *aurulenta.*
Glossy "	*vitriolina.*
Red-billed Finch Tanager	*Pitylus grossus.*
Green Black-faced Finch Tanager	" *viridis.*
Scarlet-breasted Finch Tanager	" *erythromelas.*
Blue Sackie or Tanager	*Tanagra episcopus.*
Palm "	" *palmarum.*
Grey-vented "	" *ornata.*
Cashew "	*Rhamphocoelus jacapa.*
†Blood Red Tanager (Mt. Roraima)	*Pyranga haemalae.*
†Fire-red Tanager	" *ardens.*
†Dione "	*Cyanicterus venustus.*
†Black Butcher-Bird Tanager (*melaleucus*)	*Lanio atricapillus.*
†Red Quick-singing Tanager	*Tachyphonus rufus.*
†Mournful-singing Tanager	" *luctuosus.*
Scarlet Tanager	" *phoeniceus.*
Crested singing Tanager	" *cristatus.*
Tawny Tanager	" *surinamus.*
†Dark-throated Wood Tanager (?)	*Nemosia nigrigula.*
Capped Wood Tanager	" *pileata.*
Quit-quit " "	" *guira.*
Yellow-throated Tanager	*Hemithraupis flavicollis.*
Olive-banded " (?)	*Mitrospingus oleaginus.*

Magpie	Tanager	*Cissopis leveriana.*
†Half-mantled	„	*Schistochlamys atra.*
Olive-green	„	*Saltator magnus.*
*Olive	„	„ *olivascens.*
Great-billed	„	„ *maxillosus.*

Procniatidae.

†Green Swallow-billed Tanager	*Procnias viridis* (*tersa.*)

FINCHES.

Finches form an enormous family containing no less than two hundred and fifteen genera with some seventeen hundred and sixty species. Representatives are found in all quarters of the globe. The common English Sparrow may be taken as a type from which there is no marked deviation; some half a dozen genera possess crests, several species have longer tails, and the mandibles cross each other in *Loxia.* Most genera are smaller than the type taken and a few are somewhat larger. All may be recognised by their cone-like beaks and their hard, trim, feathers. The tail is generally moderate and square, the wings are rounded. The beak is enormously enlarged in several genera, notably in *Oryzoborus*, and comparatively slender in others; it often has a notched maxilla.

Nearly all Finches have a song of some kind—frequently beautiful, as in the domestic canary. The coloration is generally sober, browns and blacks being common, with sometimes patches or bars of white, or some bright hue. The breast may become red, or redder, during the nesting season The sexes are often alike, but not always so, the female being much more modified in tone. There are delightful exceptions, some Finches being very brilliantly coloured, as, for instance, the 'Avadavats' of India and some of the Australian forms.

The nests vary considerably: the Sparrow making a great untidy, domed structure, others a neat, cup-shaped nest adorned with moss and lichens; the eggs are equally various, bluish, whitish, or greenish with spots, freckles, or streaks of different hues. They feed mostly on seeds, but generally feed their nestlings on insects, and also add fruit and buds to their bill of fare.

FINCHES—(Colonial). *Fringillidae.*

*†Blue Finch	*Cyanocompsa rothschildi.*
*†Grey-azure Finch	,, *glauco-caerulea.*
Red-vented Grosbeak	*Oryzoborus torridus.*
Black Silver-bill Grosbeak (Twa-twa)	,, *crassirostris.*
(?)	*Pyrrhulagra propinqua.*
†Pearl-grey Grass-bird	*Sporophila (spermo-) grisea.*
†Lead-grey ,, ,,	,, ,, *plumbea.*
	,, *whiteleyana.*
Chestnut-breasted Grass-bird	,, *castaneiventris.*
†Red-bodied Grass-bird	,, *minuta.*
*†Hooded ,,	,, *cucullata.*
Ring-necked ,, (Black and white)	,, *lineata (americanus.)*
Moustache Finch	,, *lineola.*
,, - Side-spotted Finch	,, *ocellata.*
*†Spotted Grass bird	,, *gutturalis.*
Grey-vented ,, (?)	*Catamenia homochroa.*
†Radiant Silly-Finch (?	*Euethia fulginosa.*
,, (?)	*Volatinia splendens.*
Black Finch	,, *jacarini.*
Yellow-crested Finch	*Chrysomitris (Spinus) ictericus.*
Long-billed (?)	*Spinus longirostris.*
Canary Grass-bird	*Sycalis arvensis.*
Earth-vented Grass-bird	,, *luteiventris.*
†Lesser ,,	,, *minor.*
Yellow ,,	,, *flaveola.*
Earth-brown ,, (*Pseudochloris*)	,, *lutea.*
†American Piping Finch (?)	*Spiza americana.*
†Striped Bunting or Fly Piping Finch (Ammodromus)	*Myiospiza manimbe.*
†Small capped Finch (Zonotrichia)	*Brachyspiza pileata.*

†Red-necked Sparrow-like Finch (Mt. Roraima)	*Brachyspiza macconnelli.*
Long-tailed Finch	*Emberizoides macrurus.*
*†Citron-coloured Finch	*Pseudochloris citrina.*
Crested Fire-Finch (Scarlet-crested)	*Coryphospingus cristatus.*
Crimson-headed Finch	*Paroaria gularis.*
Black-cheeked "	" *nigrigenis.*
†Mute collared "	*Arremon silens.*
Brown-headed "	*Buarremon personatus.*

(To be Continued.)

Wax of Wild Bees in the African Colonies.

The trade in wild beeswax is constantly increasing in most of the African colonies, especially in Gambia, Gold Coast, Nigeria, Angola, Sudan, Uganda, British East Africa, German East Africa, Mozambique. A few years ago the exportation of wax from these countries was almost insignificant, while now it amounts to thousands of tons. Wax occupies the third place in the export trade of Angola (Benguela supplying 90 per cent. of the exports of the whole province). Angola exports every year 600 or 700 tons of wax: Mozambique about 100; Portuguese Guinea 50. The wax is exported in cakes weighing 253 to 264 lbs. each. German East Africa, in 1911, exported 802,374 lbs.; British East Africa, in 1912-13, 7,552.

—"The Colonial Journal," July, 1915.

The Nation's Choice.

A nation must adopt one of two ideals—either to be a great nation producing great work, men of high intellect and character, and men who prefer to serve the world rather than to serve themselves; or to be a nation of politicians, of persons who try to obtain wealth without labour, of those who look only to the main chance, of trumpery, journalism, a contemptible stage, cinematograph shows, public-houses, silly processions, superstitions which call themselves religion, and streets full of untidy loafers with cigarettes in their mouths. We have not yet quite sunk to the latter level, but the efforts of our politicians before the war were, perhaps, largely tending in that direction.

—"Science Progress," October, 1915.

The Cultivation of Vegetables.—IV.

(*By J. F. Waby, F.L.S., I.S.O.*)

In my article on the above in "The Journal of the Board of Agriculture." Vol. VIII., July and October, 1914, Nos 1 and 2, page 14, a valuable novelty in a form of *Dolichos* is mentioned.

I have had ample opportunity of observing this particular bean and I have no hesitation in pronouncing it to be the best yet introduced for "human nature's daily food." On account of its similarity in the pod to the "Scarlet Runner" of the old country, it was given that name; but as its flowers are of a pale purple colour such a name can scarcely cling to it and would probably be pronounced absurd. As is was introduced to me by Mr. John Park, I think the "Park Runner" will be a decidedly distinctive and suitable name.

The full grown bean is 4½ inches long, ⅞ inch wide, flat till the seeds are formed, pale green and slightly rough on the ventral suture. The ripe seeds are either blackish-brown or brown-speckled; both colours are sometimes found in the same pod, though there are more darker coloured seeds than brown. The plant is by no means common, but deserves to be grown everywhere. I am very anxious that such an excellent vegetable should be well known and I heartily recommend it to everyone who cares to grow it. Taken as it grows to full size, before the seeds are in evidence, and used as French beans, commonly known as "cinnabones," it is equal in flavour—if not preferable—to these; while it is much less troublesome to grow, and far more prolific.

A LOST VARIETY.

Another bean mentioned on the same page of this same Vol. VIII., *Dolichos Lablab* var., *nankinicus*, seems to all intents and purposes to be absolutely lost to cultivation here. If it is lost altogether it is a decided misfortune, because it is the only variety which can be used as are the "green peas" of "home." A

brown seeded variety—in all other respects similar—is very common, but the seeds being brown, do answer the purpose of "green peas" as the white form does. If anyone has this white-seeded variety growing and will communicate with me, I shall be very grateful, as it has been asked for by the Bureau of Plant Industry at Washington, U.S.A.

A variety of *Dolichos Lablab*, sent to me last Spring from the Washington Bureau of Plant Industry and issued by the firm of Messrs. Vilmorin-Andrieux & Cie, Paris, France, and named by them "Stringless," is likely to prove a most useful adjunct to our tables. In Bulletin 318, U.S. Department of Agriculture, dated 18th November, 1915, this variety is referred to as follows:—

"A vigorous, very viny sort when planted in 3-foot rows, making a solid mass of herbage 30 inches deep; herbage green; leaflets large; flowers rather large, white, in compact panicles, or short peduncles; immature pods very flat, broad, 4 inches long, fleshy, white, shrinking in maturing. . . Seeds large, plump, reddish purple in colour (brown). The green pods of this variety make a most excellent vegetable, very similar to snap beans, but even more delicate in flavour. This variety should be grown largely as an arbour vine, as it is not only ornamental, but also produces an abundance of delicious beans."

I have the variety growing and can endorse fully the above statement as to its usefulness and delicious flavour. It is not altogether stringless, however. I have supplied the Botanic Gardens with this variety and it can be seen growing there in the vegetable garden.

THE VALUE OF THE SWORD BEAN.

Referring to the Sword-bean, mentioned on page 34 of Vol. IX., No. 1 of November, 1915 of the Journal of the Board of Agriculture, I would emphasize the desirability of making this vegetable well known to the public generally, especially to the poorer classes, at this time when it is necessary to grow any and all kinds of provisions in view of a possible scarcity. We do not know what we may

have to face as the result of this terrible war raging in Europe Already flour is scarce in the West Indian Islands and Dependencies, and although we are favourably situated and need not fear for the immediate future, still we may not be immune from the threatened scarcity, and it behoves us to do all and everything we can to meet such a contingency should it arise. This bean will grow almost anywhere and with no more trouble than just breaking up the ground and planting the seeds in any open spot. It will thrive sprawling on the ground without support, or on stakes or fencing. Grown in large quantities and allowed to ripen, the seeds could be easily shelled and ground into meal which might be used in the same way as plantain, cassava, or corn meal, and would probably make a good flour even if it be coarse. An article of this kind, which can be grown at a minimum of cost and labour, would be a great boon to villagers and poor folks generally. If waste ground were prepared—and there is plenty of it—by simple forking, and the seeds put in just at the time the rainy season sets in, there would be absolutely nothing to do till the beans were ripe. The plants would cover the whole of the ground in a short time and prevent any weeds growing, so there would be no weeding to do and the rain would supply the necessary moisture. In three months there would be a good crop of ripe beans to harvest. There do not appear to be any destructive insects affecting this plant, probably because of its rampant growing and its being of a decidedly harsh nature.

"BROAD-BEANS."

When we go to England or Canada in the summer months we are delighted to get a chance of a good dish of "Broad-beans," a vegetable we never have a chance of enjoying in the tropics; yet, in this bean we have a similar article, and, used in the same way, we can enjoy "Broad-beans" to the full.

As a matter of fact, we have a large number of beans in our midst which we neglect to make use of as we should. We come across Bonavists in our daily rambles, of one sort or another, but always in small quantities, growing on palings, old bushes, and out-of-the-way places, which give a dish here and there, but we rarely, if ever, find a large

patch grown for particular purpose, such as supplying a family with a quantity two or three times a week; and yet this can so easily be accomplished. A dozen plants grown with a little care are enough to supply a small family for several months with two or three dishes a week, the beans being picked, as a rule, as they become full and used as shelled peas, and the "Runners" the same. These, picked just before the seeds form, will produce sufficient "Snap beans" for any ordinary family and prove a delight to those who crave "French beans" without the worry these cause, and at a far less expense.

A Very Destructive Flash of Lightning.

In the night of January 10th-11th, 1914, a grove of coconuts on the coast near Bedok, east of Singapore, was struck by lightning, and the number of trees which died at once or slowly over the months which followed, amounted to one hundred and four.

The case is recorded on account of the extent of the damage, and of the fact that the cause of the death of the trees is in this case indisputable.

—"The Gardens Bulletin," Straits Settlements, August 31, 1915.

Why England Lost the Dye Industry.

At the time Sir W. H. Perkin sold his works in Greenford Green, the British alizarine industry was well established, but the fact that, whilst the German firms were devoting large sums to the investigation of everything even remotely connected with the production of synthetic alizarine, in England continuous and systematic research work was not undertaken to any extent, soon lost us the lead that had for a second time been given to the British industry by its founder, so that the German firms continuously gained ground on the British concern, and in 1909 Germany was exporting close on 10,000 tons of alizarine and related dyes, covering by far the greater portion of the world's demand.

—"Science Progress," October, 1915.

Report on Cokerite Fruits and Oil from British Guiana.

The samples of cokerite fruits and cokerite kernel oil, which are the subject of this report, were forwarded to the Imperial Institute by the Director of the Science and Agriculture Department in August, 1915.

The fruits were submitted by the Imperial Institute for identification to the authorities of the Royal Botanic Gardens, Kew, who stated that they were derived from a species of *Maximillian*, possibly *M. regia*.

DESCRIPTION OF SAMPLES.

Fruits.—The sample weighed 18 lbs., and consisted of dark brown fruits, rounded at the base and pointed at the apex, measuring 1½ to 2 inches in length and from ¾ to 1 inch in diameter. The rounded end was covered by a thin, papery bract.

Each fruit consisted of pericarp, nut and kernel. The dark brown pericarps were tough and fibrous externally, whilst internally they were soft and pulpy and contained oil. The nuts, which were of a pale brown colour, measured from 1½ to 1¾ inches in length and from ½ to ¾ inch in diameter, and consisted of a hard, woody shell enclosing 2 or 3 kernels.

The kernels were long, narrow and flattened in shape, measuring about 1 inch in length and ½ inch in breadth. They were covered with a greyish-brown mottled skin, whilst internally they were whitish and resembled palm kernels in consistency.

Oil.—The sample of kernel oil weighed 6 ozs. and consisted of a fairly hard cream-coloured fat, with an odour resembling that of coconut fat. It was free from dirt and moisture, and appeared to have been well prepared.

RESULTS OF EXAMINATION.

Fruits.

The fruits were found to have the following composition by weight :—

	Per Cent.		Per Cent.
Bracts	12.4	Pericarp ..	17.0
Shell	53.6	Kernels ..	17.0

The nuts consisted of shell, 76 per cent. and kernels 24 per cent.

The average weight of a fruit was 10.6 grams, of a nut 7.5 grams, and of a single kernel 1.3 grams.

Pericarp Oil.

The brown oily pericarp contained 12.1 per cent. of moisture and yielded 15.0 per cent. of a semi-solid, orange-red oil, equivalent to a yield of 17.1 per cent. from the dry pulp or 2.6 per cent. from the whole fruit. The oil was submitted to chemical examination at the Imperial Institute, and the results are shown below in comparison with those recorded for palm oil (the pericarp oil of the fruit of the oil-palm *Elaeis guineensis.*)

	Cokerite pericarp oil	Palm oil.
Solidifying point of fatty acids ..	25.5°C	35.8°-46.4°C (usually 44.5°-45.0°C)
Acid value* ..	28.6	..
Saponification value* ..	211.6	196.3-205.5
Iodine value, per cent. ..	51.4	53-57.4

This cokerite pericarp oil resembles palm oil in appearance, but it obviously differs somewhat from it in chemical composition. There is, however, no doubt that cokerite pericarp oil would be readily marketable if it could be obtained in quantity.

Kernels.

The kernels, as extracted from the fruits at the Imperial Institute, contained 11.3 per cent. of moisture and yielded

* Milligrams of potash for 1 gram of oil.

56.9 per cent. of a fairly hard cream coloured fat with an odour resembling that of coconut oil. This is equivalent to a yield of 64.1 per cent. of oil from the dry kernels, or 9.7 per cent. from the whole fruit.

The kernel oil forwarded from British Guiana and the oil extracted from the kernels at the Imperial Institute were examined with the following results, which are compared with those recorded for palm kernels and coconut oils:—

	Oil prepared in British Guiana.	*Oil prepared at Imperial Institute.*	*Palm Kernel Oil.*	*Coconut Oil.*
Specific gravity at 100°/15° C	0·861	0·8668	0·8731	0·8736
Melting point (open tube)	25·5°C	27°C	23 to 30°C	23° to 27°C
Solidifying point of fatty acids	..	24·2°C	20° to 25·5°C	21·2° to 25·2°C
Acid value*	4·6	3·1		..
Saponification value*	252·3	253·0	242·4 to 254·8	225 to 268·4
Iodine value, per cent.	12.8	13·0	10·3 to 17·5	8·0 to 10·0
Hehner value	..	88·9	91·1	88·6 to 90·5
i.e., Insoluble fatty acids, per cent.	..	88·6		
and Unsaponifiable matter, per cent.	..	0·3	..	.
Volatile acids, soluble†	..	3·0	5·0 to 7·6	6·65 to 8·0
Do. insoluble†	.	7·0	10-12	15 to 20

*Milligrams of potash for 1 gram of oil.

†Cubic centimetres of decinormal alkali required to neutralise acid from 5 grams of oil.

The results indicate that the oil obtained from cokerite kernels is similar to palm kernel and coconut oils, the chief difference being that it yields somewhat smaller quantities of volatile acids.

Kernel Meal.

The meal left after the extraction of the oil from the kernel was a pale brown material, with a mild and not unpleasant taste somewhat suggestive of coconut. It was submitted to chemical examination at the Imperial Institute, and the results have been re-calculated for a cake

containing 7.0 per cent, of fat so that they may be conveniently compared with the figures recorded for palm kernel and coconut cakes:—

	Cokerite meal (calculated for cake with 7·0 per cent. of fat).	*Palm kernel cake (expressed).*	*Coconut cake (expressed).*
Moisture	8·6	10·8	8·5
Crude protein	15·0	16·1	24·5
Consisting of—			
True proteins	14·7	...	...
Other nitrogenous substances	0·3	..	...
Fat	7·0	6·2	8·3
Starch, etc. (by difference) ..	52·5	48·5	39·8
Fibre	12·6	14·8	12·8
Ash	4·3	3·6	6·1
Nutrient ratio	1 : 4·4	1 : 3·9	1 : 2·42
Food units	108	104	122

The foregoing results indicate that the residual meal from cokerite kernels should have a feeding value approximately equal to that of palm kernel cake and somewhat lower than that of coconut cake.

COMMERCIAL VALUE OF COKERITE FRUITS.

It will be seen from the foregoing that the cokerite fruits have a structure analogous to that of oil palm fruits (*Elaeis guineensis*), and that like the latter, they furnish two products which need consideration from a commercial point of view, viz.—

(1) *pericarp oil.*

(2) *kernel,* yielding oil and feeding cake.

The principal difference between cokerite and oil-palm fruits, so far as commercial value is concerned, is that the former have a thin pericarp, giving a comparatively small yield of oil, whereas oil-palm fruits have a thick, soft pericarp, rich in oil. The essential differences be-

tween the two kinds of fruits are shown in the following table:—

	Percentage by weight in the fruit.		
	Pericarp.	*Pericarp oil.*	*Kernel.*
Cokerite fruits	17.0	2.6	17.0
Oil-palm fruits—			
(*a*) with thick-shelled nuts..	25 to 36	16 to 19	13 to 19
(*b*) „ thin- „ „ ..	69 to 83	35 to 48	7 to 9

In West Africa only oil-palm fruits with thick-shelled nuts are obtainable in sufficient quantity to be worth working, and consequently only this variety need be considered for comparison in the present instance. It is clear that since this variety of oil-palm fruits yields nearly seven times as much pericarp oil (palm oil) as cokerite fruits the latter form a comparatively poor source of pericarp oil, and it is scarcely worth while to consider them as a commercial source of this product, except as a possible by-product in working the fruits for kernels.

The yield of kernels on the other hand compares favourably with that from the best varieties of oil-palm fruits, viz., thin-shelled oil-palm fruits. Moreover, since the kernels yield rather more oil than palm kernels and the oil itself is quite comparable with palm-kernel and coconut oils, there can be no doubt that cokerite kernels would fetch the same price as palm kernels, or possibly a little more. The present price of palm kernels in Liverpool is £26 10s. per ton (18th January, 1916.)

The sole question, therefore, is as to whether cokerite kernels can be produced in British Guiana at a price which will admit of their being sold in Liverpool at about the same price as palm kernels. In this connection it is important to ascertain whether the fruits are obtainable in British Guiana in large quantities in easily accessible areas, and the Imperial Institute will be glad to have information on this point. Further, it would probably not be remunerative to export the whole fruits from British Guiana, so that it becomes important to consider the extraction of the kernels. It would probably not be possible to do this by hand in British Guiana, and so far as is known at the Imperial Institute there is at present no machine suitable for this purpose.

The extraction of the babassu kernel, however, presents a similar problem. It is stated that a machine is now in use in Brazil for extracting babassu kernels, and the Imperial Institute is making enquiries there on this subject. It is possible that this machine will also be suitable for cockerite fruits, and if so it might be feasible to treat the cokerite fruits in the machine to obtain a mixture of (*a*) kernels and (*b*) shells and pericarp. The former could be separated and exported, whilst the mixed shells and pericarp could perhaps be worked by a modern extraction process for the production of pericarp oil.

Until information is available regarding the Brazilian machine all that can be done is to ascertain whether the supplies of cokerite fruits in British Guiana are large and sufficiently accessible to warrant their serious consideration as a workable product If this seems likely, the Imperial Institute will be glad to have a consignment of about 6 cwt of the fruits for technical trial.

Preservation of Flower Colour in Herbarium Specimens.

Botanical specimens are commonly deprived of all beauty, and much of their value by the loss of colour in the flower-heads. This very serious drawback has now been removed by the timely discovery of a method of colour preservation by Dr. C. F. Fothergill and described in detail in "The Museums Journal" for July. It has the further merit of extreme simplicity Briefly, Dr. Fothergill employs sheets of absorbent cotton wool, placed in three layers forming two compartments between two "grids" which are made of a "wire-mesh work of half inch squares with a heavy encircling band." The necessary pressure is obtained by fastening one or two straps, preferably of webbing, around the grids, and tightening them as required. The flowers to be pressed, having been placed in the grids, are then suspended in front of a fire, or in the sun, when this is sufficiently powerful. The explanation of the success of the method is, that the process of drying is so rapid that the pigment is fixed instead of being slowly decomposed. Fresh carnations can be preserved in about seven hours. Primroses picked fresh off the living plant can be permanently dried to retain a lifelike colour in two hours if the press containing them is placed in the oven."

—"Nature," September 2, 1915

Meeting of The Board of Agriculture.

A MEETING of the Board of Agriculture was held at the office of the Board, Broad Street, on the 2nd November, 1915, His Excellency the Governor (Sir Walter Egerton, K.C.M.G.), presiding.

A resolution of regret at the death of Mr. Maynard Payne, B.A. LL.B., who had been a member since July, 1906, was unanimously adopted.

THE GINGER LILY.

It was reported that it had been decided to terminate the experiments with the Ginger Lily (*Hedychium coronarium*) as a paper producing plant: it had been proved that the plant could be grown in the Colony in large quantities, but there was at present no market for it: also that the West Bank Farmers' Association held a Show on 19th October, 1915, at which the exhibits were small in number but good in quality. The attendance was very poor. Mr. Earle pointed out that the small attendance was due to the people being employed on the sugar estates, which were grinding. His Excellency advised that future shows be held at a time when the people were able to attend.

"PEST" POSTERS.

The Chairman submitted two draft posters prepared by the Government Botanist and the Economic Biologist respectively, giving information concerning the principal fungus and insect pests of the colony. The posters were to be printed and sold at a nominal price.

The Chairman reported the arrival on the 28th August of a Tamworth boar and two sows, and a similar number of Berkshires. The sows were received "in pig," and had since farrowed 26 piglets, 14 Tamworths and 12 Berkshires. The piglets were being sold.

INFECTIOUS DISEASES OF STOCK.

With regard to the anthrax outbreak, the Chairman reported that the area Kitty to Mahaica, on the East Coast,

was still infected, and it was estimated that 2,000 cattle remained uninoculated. Opposition to inoculation had been met with at Mahaica. An outbreak of contagious pleuro-pneumonia was also reported. The Government of Grenada had prohibited the importation of all animals from British Guiana for six months.

SALES AT PLANT STALLS.

The Chairman further drew attention to a serious falling off in the sales at Plant Stalls belonging to the Board, and submitted the following statement:—

Stall.	*No. of Plants sold.*	*Amount.*
Georgetown ..	.. 297	$ 5.89
New Amsterdam ..	.. 860	16.68
North West Station ..	.. 46	1.38
Pomeroon .	.. 1	24

The Board decided not to close down any of the stalls, but to give the scheme a longer trial.

RICE AT D'URBAN PARK.

It was announced that the last crop of rice on the D'Urban field had been rather disappointing—22.9 bags of 120 lbs. of padi per acre. This was due to an excessive development of straw (equal to 7.3 tons per acre); to heavy rains in August inducing re-growth in the plants at the time they should have been flowering; and to an attack of fungus disease following on the rains. The results so far have been—

First Crop ..	.. 22.75	bags of 120 lbs.
Second Crop	.. 21.25*	,, ,,
Third Crop ..	.. 30.00	,, ,,
Fourth Crop	.. 36.00	,, ,,
Fifth Crop ..	.. 22.90**	,, ,,
5 Crops in 25 months ..	132.90	,, ,,

RUBBER TAPPING AT STATIONS.

The Assistant Director reported as follows on the rubber crops of the Department of Science and Agriculture, for the period February to September, 1915:—

Issorora, N.W.D.—Tapping commenced 11 Feb., 300 trees in one tapping experiment tapped daily yielded to

* attacks of birds
** attack of fungus.

September 30, (a period of nearly 8 months), 950 lbs. 2 oz. 3 drs., which is approximately equal to 570 lbs. dry rubber: cost of collecting, $37.12 or 6.5 cents per lb. dry. Another 128 trees, which are being bled separately, and which, not being sufficient for a task for one man for a half day, were not included in the above experiment, yielded 125 lbs. of dry rubber in the same period.

Christianburg.—Tapping commenced 6 Feb.; 250 trees tapped daily yielded to September 30, 235 lbs. dry rubber at a cost of 24 cents per lb. dry.

Taking both stations together 935 lbs. of dry rubber have been obtained in 8 months for $119.40 equivalent to 12.8 cents per lb. Early tappings at Christianburg cost 13¾ cents per lb. as compared with 15 cents from early tappings at Issorora. Considerable difficulty was experienced in getting settled labour for tapping, and the leaf disease having reduced the yield at Christianburg, the cost has been somewhat higher than at Issorora for the first 8 months of tapping.

The Chairman added that there were about 600 lbs. of rubber at the Gardens awaiting shipment.

HYBRID COTTON.

Samples of Buck and hybrid cottons cultivated by the Department were exhibited, and attention was drawn to the report of the Imperial Institute on the new hybrids produced by experiment.

"KAPOK."

A note by the Assistant Director on the experimental growing of the Kapok (*Ceiba pentandra*) tree at the Gardens showed that 24 plants were put out in March, 1913. They attained a height of 15 feet when 18 months old and fruited for the first time at that age. From a first sowing of 100 seeds, 12 plants, and from a second sowing of 1,500 seeds, 250 plants were raised. Two separate consignments of 1,000 seeds from the Malay States gave only 4 plants Twenty-four plants were given away at the West Bank Farmers' Show, and 200 plants were on hand.

The President stated that the tree was extensively planted in the East, and advocated the introduction of the tree

into the villages. The fibre is largely used in making life-belts, mattresses, rope and other articles.

THE PANAMA HAT INDUSTRY.

The Chairman stated that the Department had now raised upwards of 1,000 plants of the Panama-hat palm (*Carludovica palmata*) The majority were at Issorora, but about 200 were at the Gardens. The President thought that a plantation of the palm might be established at the Penal Settlement. He referred to the progress the industry had made in Surinam, and saw no reason why it should not do well here.

BOARD ASSUMES CONTROL OF GARDENS.

The Board unanimously resolved to take over charge and control of the Promenade Gardens and other Municipal ornamental Gardens from the Mayor and Town Council, for a term of five years; and also the control of the Public Free Library Garden—the Board undertaking, in the latter case, to make the sum of $140 suffice for the annual upkeep of the grounds.

An "Ornamental Gardens Committee" was then appointed, and regulations for the control of the grounds adopted.

A "Destructive Pests Committee," consisting of the Chairman of the Board and the Economic Biologist, was unanimously agreed to, the Chairman pointing out that it was necessary in cases of plant diseases and pests that prompt action should be taken

The Board then adjourned *sine die*.

Banana Flour in War Time.

Banana flour is being used as a food in the French base hospitals The banana yields about a quarter of its weight in meal and the cost of meal in the West Indies is about 2d. per lb.; mixed with wheat flour, excellent loaves and cakes are obtained, and if wheat continues to advance we might well take a leaf out of the German book and use another ingredient. This loaf is quite as nutritious as the wheaten, which is more than can be said of the "war bread."

Hints, Scientific and Practical.

The Secret of Germany's Strength.

DURING the past fifty years no other nation has so encouraged scientific research (as has Germany) and by no other nation have scientific discoveries been so readily accepted and so quickly utilized. In all legislation upon economic questions the man of science has had paramount influence, and in that greatest of all economies, the prevention of unnecessary waste and the getting out of every material thing the last drop of usefulness, the Germans, from prince to peasant, have no rival The administration of her municipal governments is a model for the rest of the world, because the advice of the scholar has been sought at every turn All of her foremost industrial enterprises have had their beginning in the laboratory. In many important lines she has controlled the markets of the world, not on account of her superior business or commercial intelligence, but because of the knowledge and technical skill of her chemists.

Whatever we may think of the outcome it cannot be denied that it is applied science that has enabled the German Empire to suddenly convert itself into a huge engine of destruction, all parts of which seem to have been so delicately adjusted to each other that the awful strain to which the whole is now subjected is distributed among the several members in exact proportion to their ability to bear it. Other nations are learning this lesson in the hard school of experience and they are paying tuition fees in blood and treasure. Fortunately for us (in the U.S.A.) it may be learned by observation as well as by experiment.

—T. C. MENDENHALL, in "Science";

December 24, 1915

The Potassic Fertilisers.

ALTHOUGH water cultures coupled with the results of the Rothamsted experiments even in their early years, showed that of the alkali metals found in the plant's ash only potassium was indispensable, for a long time the salts of potash could could not be obtained in quantities or at a price appro-

priate to agricultural requirements. Almost the only source of potash was the crude carbonate or "potashes," which was obtained by dissolving the soluble salts found in wood ashes; and though this was to a small extent supplemented by the nitrate of potash or saltpetre obtained from India, and by a certain amount of sulphate of potash obtained from "kelp"—the ashes of seaweed—no widespread use could be made of potash salts in farming until the opening up of the great Stassfurt deposits in Germany The fertilising value of wood ashes had long been known, and in the south-east of England it had been customary for the hopgrowers to organise a regular system of collection of the ashes of their cottagers, who burned little besides wood; but such a supply was only local and early exhausted.

William Ellis, again, writing in 1750, states that "at Long Marston, in Bucks, is a potash kiln, where they make ashes from bean straw for the most part, and sell a vat of them, which contains 32 five-bushel sacks, which dresses one acre, for fourteen shillings, to be shovelled out of a cart or waggon, and throwed over grass land in this month (July) or at any time till Candlemass"

In 1861, the output of potash salts began from Stassfurt and rapidly grew, until in 1900 no less than 1,158,000 tons were being used for agricultural purposes alone.

—"Fertilisers and Manures" by
A. D. HALL, M.A., F.R S.

The Rôle of Potash as a Manure.

THERE is abundant experimental evidence to show that potash makes the plant more resistant to the attacks of fungoid diseases. It has already been explained how susceptible the use of nitrogenous manures renders the mangolds on certain of the Rothamsted plots to the attack of a leaf spot fungus—*Uromyces betae*. The attack is, however, much less severe on the plots receiving an abundant supply of potash; there the plant remains healthy even though the nitrogen is in excess. Just in the same way, the wheat on the potash-starved plots is always subject to rust, even in a

good season when very little is to be seen on the other plots normally manured. The grass also on potash-starved plots is attacked by various fungi; hence it may be taken as a general rule, that crops which do not receive their full supply of potash will be correspondingly susceptible to disease.

It is not possible to say whether this is due to any specific alteration in the composition of the cell contents or to a general lack of vigour, but the latter is probable, because an excess of potash tends to prolong the vegetative growth of the plant and to delay maturity. Plants receiving potash are always a little the greener, especially late in the season, and this is not always an adventage, as may be seen from the fact that the barleys grown on the plots receiving potash at Rothamsted show a somewhat darker and less attractive colour than those grown without potash. That potash tends to prolong growth may also be inferred from the fact that its effect upon the yield is always most pronounced in dry seasons.

—"Fertilisers and Manures" by
A. D. Hall, M.A., F.R.S.

The British Science Guild.

THE great feature of the meeting, however, was the able speech of Sir William Ramsay on the Organisation of Science. While giving due praise to the efforts of all the separate scientific societies during the past ten months to utilise to the full Britain's scientific assets, he pointed out, and emphasised the fact, that nothing of a really effective nature could be done until such societies were made subservient to one central body of scientific men, to whom the Government Departments should be compelled to apply for advice and assistance. He said that the Royal Society was eminently fitted to play such a part, and read a scheme drafted by Lord Sydenham which showed how such an idea could be made practical. Sir William Ramsay, in his attempt to rouse his audience to an adequate sense of the importance of such an undertaking did not hesitate to bring to light all the shortcomings of our country by com-

paring it very unfavourably with that of France. He narrated how our Ally, as early as August 4, had called a general meeting of her Academy of Sciences, which decided to offer the whole scientific resources of the country to the French Government, and pointed to the lamentable fact that on the 1st July, eleven months later, such measures in England were still conspicuous by their absence. As a striking illustration of the slowness of Britain to alter its ideas he read an extract of an address, given sixty-three years ago by Lord Playfair on "Industrial Instruction on the Continent," which is equally applicable at the present day In it Lord Playfair remarked, "For many years foreign States, acting upon the facilities for communication, have expended annually large sums in sending highly enlightened men to our country; for the purpose of culling from our experience, and of importing it into their own land; and we see the effect of the experience thus readily acquired, when united with the high development of mental labour in the rapid growth of new industries abroad . . . With us, there is a wide-spread jealousy of science and a supposed antagonism between it and practice . . . While we continue to rely upon local advantages or acquired experience, we allow a vast power to arise abroad, which is already telling against us with wonderful effect." Sir William Ramsay also deplored the fact that no publicity is given to the work that is being done in this country. The names of the workers are studiously suppressed without any need for such secrecy, and one body of men is barely cognisant of the aims and achievements of the others. At the close of the meeting, Sir William Mather stated that a letter conveying the opinion of the meeting would be forwarded to the Prime Minister

—"Science Progress," October, 1915.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first quarter of the year 1916. The corresponding figures for the two previous years, and the averages for the four years previous to that, are added for convenience of comparison.

Product.	*Average 1910-13.*	*1914.*	*1915.*	*1916.*
Sugar, tons ...	15,876	18,785	21,259	23,806
Rum, gallons ...	690,231	1,028,245	1,216,036	1,938,593
Molasses, casks ...	445	628	...	...
Cattle-food, tons ...	2,137	760	374	520
Cacao, cwts. ...	59	208	187	29
Citrate of Lime, cwts.	...	...	17	45
Coconuts, thousands	331	579	486	650
Copra, cwts. ...	505	490	589	824
Coffee, cwts. ...	447	927	334	658
Kola-nuts, cwts. ...	..	...	2	..
Rice, tons ..	1.251	2,898	3,072	5,023
Ricemeal, tons ...	704*	98	170	78
Cattle, head ..	247	370	196	173
Hides, No. ..	1,359	1,738	753	1,399
Pigs, No. ...	544*	360	267	320
Sheep, head ...	4*	6	2	21
Balata, cwts. ...	831	2,168	3,289	2,700
Charcoal, bags ...	17,663	22,076	12,939	16,264
Firewood, Wallaba, etc., tons ...	2,472	3,215	1,914	3,817
Gums, lbs. ...	689	...	...	883
Lumber, feet ...	66,880	120,217	8,877	156.002
Railway sleepers, No.	1,503*	502	53	675
Rubber, cwts ...	1·8†	...	7	46
Shingles, thousands	581	254	441	437
Timber, cub. ft. ...	81,050	78,184	37,434	67,569

* In year 1913 only.

† In years 1913 and 1912 only.

Selected Contents of Periodicals.

The Influence of Research on the Development of the Coal Tar Industry:

The Cash Value of Scientific Research.

"Science Progress, January, 1916.

Science Teaching in Public Schools.

"The World's Work," April, 1916.

A New Interpretation of the Relationships of Temperature and Humidity to Insect Development.

A New Spray Nozzle

"The Journal of Agricultural Research,"
March 20, 1916.

Relation of Carbon Bisulphide to Soil Organisms and Plant Growth.

Ibid, April 3, 1916

Aims, Methods and Results in Medical Education.

"Science," March 17, 1916.

Scientific Truth and the Scientifiic Spirit.

Ibid, March 31, 1916.

Ensilage—Its Value and Cost of Production.

"The Journal of the Department of Agriculture,"
Victoria, Australia, February, 1916.

Over-irrigating Rice:

School of Tropical Agriculture:

Endemism and Evolution.

The Tropical Agriculturist (Ceylon),
February, 1916.

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The Botanical Aspect of the Sea Defence Problem.

WE are glad to see that the botanical aspect of the problem of sea defence is recognised in the Report by Mr. G. O. Case, the expert called in by the Government as a sequel to the recommendation of the Commission appointed to deal with this vital matter. This is, in fact, the first hint we have seen that there is a botanical side to the problem, for the Report of the Commission itself contained no reference to this aspect of the question; yet in all countries which have to take into serious account their defence against the inroads of the sea, the rôle of plants as agents in building natural ramparts is one which is studied as minutely and as painstakingly as is the form and structure of mechanical obstacles to the destructive march of the ocean. Rightly considered, the two aspects of the problem are complementary—one makes good the deficiencies of the other. Natural bulwarks are the cheapest, and while they are not impregnable against storms or extreme forms of erosion (when they have to be supplemented by artificial contrivances) they can be made to form the bulk of the sea defences over great areas. Moreover, they have proved themselves, within their obvious limits, thoroughly efficient. The art of the engineer endeavours to utilise the energy of the sea itself to form its own barrier, coaxing it

to deposit the sediment it carries in suspension and nowhere giving it an excuse to exert its latent power; the art of the botanist is directed to choose such plants as can live in the conditions obtaining on the shore and by slowing down currents induce the deposition of silt, and above all by arresting the wind-blown sand, build up stable dunes and banks between the water and the land. And the botanist's activities have the inherent advantage that his defences, like the timber trees the old Scotsman advised his son to plant, "are aye growing while ye're sleepin'."

So far as we have been able to ascertain, only one account of work of this character done in this colony has been published, and we propose to quote freely from the article, which will be found in "The Journal of the Board of Agriculture of British Guiana," Vol. I. No. 3, (January, 1908). "As the subject was of much importance," writes the then Editor, Mr. A. W. Bartlett, "it was brought before the Board of Agriculture and some valuable information was obtained. . . . A question was addressed as to the value of the Courida in resisting coast erosion. It appeared to be the general opinion that Courida was very unsatisfactory. The roots do not penetrate deeply but feed for the most part on the surface, and the consequence of this is that the full-grown trees which often attain to a considerable height, are easily blown down by a strong wind and readily uprooted by a slight wash. The overthrown trees, unless quickly removed, are capable of doing much damage to the sea defences when washed about by the waves. On the other hand, the Courida appears to be of some use in withstanding the encroachments of the sea when left undisturbed. . . The Mangrove, on account of its abundant wide-spread and deeply seated system of roots, which enables the tree to withstand heavy seas and strong winds was considered to be of much greater value than the Courida in protecting the foreshore against erosion. . . .

"John Junor, Esq., the Manager of Pln. Vryheid's Lust, made mention of a grass known as 'wild rice' which has been of great saving to the foreshore of Better Hope and New Montrose estates, where he has been planting it for

some years past. I took an early opportunity of visiting the place where the grass had been planted. For a length of about 100 rods this grass covers the higher and upper parts of the foreshore which it has largely helped to build up, and there are large patches of it growing in various places in the soft mud on the lower parts of the shore, which are covered by the sea twice every day at high tide. Except for young Mangrove trees planted in places of the shore which have been built up by the mud accumulated by this grass, it appears to be the only plant which is able to become established in the soft shifting mud on the seaward side of the fringe of Courida. Mr. Junor noticed this grass many years ago growing on the banks of the Demerara river at both Vriesland and Providence plantations and observed how the soil accumulated around it, which led him to test its powers in protecting the shore from erosion when he became Manager of Pln. Vryheid's Lust. His experiments were entirely successful, and after the grass had become established he tried planting mangrove trees amongst it, so that to-day there is a forest of these trees springing up and requiring no further attention.

"The grass appears to be identical with specimens of *Spartina brasiliensis*, Raddi., in the herbarium of the Botanic Gardens. . . Mr. Junor informs me that he plants the tufts of the grass in rows, the rows being six feet apart and the plants in the rows separated by a distance of two feet The depth at which the tufts are planted is about one foot below the surface. The grass spreads quickly so that in a short time the plants meet to form a patch, the numerous stems of which serve to fix the mud and prevent it from being washed away by the sea. Even should the mud cover up the plants after they have been planted, they are able to make their way through it in time.

"When the grass is firmly established Mr. Junor's plan is to plant the seedlings of the mangrove in amongst it. . . . There follows a great development of roots both from the trunk and the branches (of the mangrove), which, after the manner of flying buttresses firmly support the tree in the soft mud and enable it to withstand the strongest breezes and the heaviest seas. These aerial roots being

more or less curved, allow a certain amount of 'give' or play which is often of advantage in enabling a structure to withstand pressure without collapsing. So the mangrove tree is in many ways particularly adapted for growing along muddy sea coasts which are exposed to winds and waves The young plants grow rapidly and in a few years will themselves produce a crop of seedlings. The club-shaped seedlings are obtainable in abundance along the coast, and should be gathered for planting when they are nearly ready to fall. All the planting that is required is merely to insert the lower pointed end of the seedling in the mud. When the mangrove trees have grown to a fair size they form a close shade, and so far as my observation goes they kill out the 'wild rice' which appears to require full exposure of the sun's rays for at least a part of the daytime, for its successful growth. But by the time that the mangrove trees have reached a sufficiently large size to do this, they will themselves have taken over the function of the 'wild rice' in preventing coast erosion and hence the latter is no longer required."

We have been unable to procure any information as to the present condition of the foreshore mentioned in this interesting article, but sufficient time has now elapsed for a sound judgment to be formed of the success or otherwise of Mr. Junior's ingenious scheme. The only other reference to "wild rice" for purposes of sea defence that we have been able to discover is in the valuable "Brief History of the Sea Defence Work of the Public Works Department" by Mr. L. P. Hodge, attached as an appendix to the Report of the Sea Defence Commission On page 86 it is stated that the grass was planted in a space enclosed by groynes and that "the result has been a very satisfactory warping of the shore."

These extracts will serve to show what a very great deal we do not know regarding the botanical aspect of the sea defence problem as it affects this colony. The foreshore does not consist entirely of mud: sand also occurs: and we understand that this is considered the most valuable material for forming a natural protection for the coast, and that the result of Mr. Case's scheme will be the formation of stabilised areas of such material at the land ends of the groynes. But how long will such stabilised areas

last under the constant erosion of sub-aerial agencies, if they are not protected by suitable vegetation? In the light of our present knowledge, no answer can be given. We have no data. There have been no scientific investigations into the factors which determine the distribution and growth of the shore flora of the colony, or to settle the precise value of the plants from a sea defence point of view. No experiments have yet been made to ascertain whether or not exotic plants of proved value elsewhere will retain their virtue in the conditions prevailing in British Guiana. All such points have been, and are, the subject of detailed experiment in other countries, as can be seen from the literature of the subject.* With the engineering side of the problem in British Guiana already tackled in so promising a fashion, the time seems to be opportune for the undertaking of the botanical aspect. If carried through in a scientific spirit and in an exhaustive manner, the results must be of extreme value to the colony, and would complete in the only satisfactory way the solution of a problem which has worried the colony already too long

*For an excellent summary see "Coast Sand Dunes," and "The Use of Vegetation for Reclaiming Tidal Lands," by Mr G. O. Case.

Science and Truth.

Science, then, is not infallible and never can be. Equally lacking is the quality of infallibility in scientific truth. The essence of a truth in science lies in its power to explain phenomena in a satisfactory way. If it does not do this, then it is not a truth. In a certain stage of the development of scientific knowledge a theory is found to explain or relate all the known facts in a particular range of phenomena. This is the source of the satisfaction it gives to the scientific mind, and at that stage it is accepted as a truth. But subsequently discovered facts in the same province may refuse to be so explained or related, and the previously accepted truth will, consequently, be discarded for that one will give this service.

—"Science," March 31, 1916.

Lessons with Plants in British Guiana.

By the Editor.

"*It is finding answers to questions which chiefly deserves to be called Science.*"—L. C. Miall, F.R.S., in "Teaching and Organisation."

VIII.

ADAPTATIONS TO EXCEPTIONAL CONDITIONS.

If you have carried out intelligently the simple experiments suggested in the previous articles of this series, you will have found out by the best possible method—experiment—that ordinary plants absorb water by their roots and give it off by their leaves, need a good supply of air below ground so that the delicate, active cells of their roots may live and do their work properly, require good soil from which to get food, and must have sunlight if they are to thrive. But simple observation of the plants of the colony will show that many plants live high up among the branches of trees where they are quite away from any possible connection with the ground and its supply of food and water, others flourish in trenches, ponds and swamps in the mud of which no air of a breathable quality is likely to be found, while many grow on sand reefs in which the supply of food is poor and the available water is obviously at a minimum except during the rainy season. Evidently, these plants have by some means or other overcome the difficulties of their environment—have solved the problem of existence in seemingly impossible conditions—and it will be of interest to try and discover, if we can, how they have done it.

Let us consider for a moment the reason why these plants have had to take to such difficult places in order to live. This is to be found in the Struggle for Existence to which we have referred in a previous article. The best places in the world are naturally the objects of the greatest competition, and are very early and quickly occupied. The fight for such places is constant and relentless, the one penalty of failure is death. Every species which can ob-

tain a foothold strives to oust every other species, the struggle between individuals of the same species is even keener. Plenty of "elbow room" is to be had only where conditions are difficult—even impossible, apparently. The more forbidding the prospect, the more space there is available, but the less the chance of survival. Not that competition is less keen. Countless numbers of seeds attempt the impossible, and perish. Competing species crowd to the edge of the vacant space, and the slightest improvement of the prospect, the smallest modification in the limiting conditions, gives some of them the chance they were waiting for. Meanwhile a few, fitted by some peculiarity of constitution or structure to live in the apparently impossible conditions, take every advantage of their opportunity, even improve by selection their initial peculiarities—for competition amongst themselves is as uncompromisng as ever—and people the vacant spot.

THE STRUGGLE FOR LIGHT.

Take the case of a very common plant—not so common in Georgetown since the advent of modern sanitary science—the *Catopsis nitida*, usually, but incorrectly, called a "parasite." Its graceful funnel-shaped tufts and bright red spikes were a common sight on the Saman trees in Vlissingen Avenue, until the authorities condemned them as a mosquito-breedng nuisance. It is said that cartloads of them were removed, and that the men who did the work were thoroughly drenched by *the water the plants had stored up in their funnel-leaves.* Climb up yourself to a limb on which some *Catopsis* is growing and convince yourself that the story is true in this respect. Carefully examine the water in the funnel. You may find live mosquito larvae; you will almost certainly see dead insects and rotting leaves which have been blown there or have fallen from near-by trees. Detach the Bromelia from the branch on which it is growing. Note whether or not the roots actually penetrate the bark. Examine the roots. Are they large, thick, long, tangled? Do they gather much dust? Do they collect anything of which a "soil" could be made? Take special note of the surface of the leaves, both below and above the water. You will be unable to make out much without the assistance of a microscope, but you should observe white, dry scales. Below the water

level these serve as *absorbing organs*, and their structure is interesting. They are really broad, flattened hairs, made of thin permeable cellulose in contrast to the thick, impervious cuticle of the surrounding leaf-epidermis or skin, and by means of these the plant takes in the water impregnated with leaf-mould and decaying animal matter which has collected in the leaf-funnel. This the *Catopsis* as a result of a wonderfully efficient adaption, carries with it its own food and water, and is free to occupy the highest and dryest places it can find in its search for the essential—all-essential—light. How successful the plant is in the struggle for existence is proved by the most casual acquaintance with the bush, where every dead tree and many living limbs are thickly covered by members of this genus.

THE "SEMI-PARASITIC" LORANTHUS.

An instructive comparison can now be made between the *Catopsis* and the *Loranthus* or "Bird-vine." You will find the plant almost everywhere, especially on Casuarina trees, a measure of care or neglect, and you can adopt the same method of investigation as in the case of the *Bromelia*. Examine the roots. Try to pull the plant from its host tree. Pluck a twig with *Loranthus* on it, and then cut transverse sections of it with your knife, just where the roots or *haustoria* penetrate the bark. How far do the roots penetrate? Recall the simple experiment of placing a cut branch in water coloured with a red dye, such as eosin or safranin, to determine the course of the water—the "transpiration current"—through the young wood, and realise what advantage the *Loranthus* secures by "tapping" its host for the water and salts in solution which it needs for building up food material. Note that the Bird-vine has green leaves, which contain chlorophyll and can therefore use the carbon dioxide gas and water vapour of the air for the manufacture of carbohydrate. It depends on its host for only part of its raw food-stuff, and is therefore only partially parasitic. Note also that it is no advantage to such a parasite to kill its host: the most favourable case is when the host remains alive and well to supply food material to the parasite. In old-established plant and animal communities, therefore, we find native parasites do little or no damage, but should a new member be introduced, the prob-

lem of protecting it from fatal attack is often a difficult one. The point is important in connection with the sanitation of introduced economic cultivations.

EPIPHYTES.

The *Catopsis* is termed an *epiphyte* or plant which lives upon—up on—another plant but does not depend on its support for food; and epiphytic vegetation is a very characteristic feature of British Guiana and of Tropical South America generally. Take a walk through the Nursery in the Botanic Gardens and study the orchids there. Again devote your attention to the roots. How many kinds can you distinguish? Some hang down, some cling to the supports, some project straight up into the air. Note any differences you can in them. Do you find any dead leaves and dust caught by the projecting roots? Anything like a "soil"? The hanging "aerial" roots are worth careful inspection, for their tips (any root-caps?) are often green and their white parchment-like covering is very noticeable. This is called the "velamen," and can absorb any water which may run over it during showers, and retain it for the use of the plant. A cousin of the *Catopsis*—the "Old Man's Beard" or "Spanish Moss" (*Tillandsia usneoides*), which can be seen on many trees in Berbice and elsewhere hanging in grey-green masses from the branches of trees—does the same thing, but the absorbing organs in this case are not roots—for the plant has none—but the linear leaves which are covered with scales similar to those we saw in *C. nitida*.

XEROPHYTIC CHARACTERS.

You will of course notice that the orchids have no funnel arrangement for collecting water in bulk. Evidently they will have to conserve carefully the water they do absorb. The leaves are thick and leathery, and below them are curious swellings—*pseudo-bulbs*—which serve as water storage organs. The water problem is obviously a very serious one for epiphytes, and we find that they all exhibit *xerophytic* characters—that is features adapting them to live in dry conditions. As a rule they cut down their transpiration to a minimum, have a thick cuticle, and deeply-sunk stomata, sometimes possess "aqueous tissue" in which water is stored, and occasionally have a mucilaginous or gummy cell-sap

which dries with great difficulty and holds liquid very tenaciously. Capital illustrations of this last feature can be found along the Sea Wall. The groynes towards their far ends are covered with brownish-red seaweed (locally called "moss"), which is wetted with water only twice a day, at high tide, and for the greater part of twelve hours has to withstand the heat of the tropical sun beating on the exposed stone. Experiment will prove to you that these seaweeds are remarkably slippery—mucilage—and that even during the heat of the day they are moist—mucilage. Again if you walk along the coping of the wall opposite the Rifle Ranges after it has been wetted by a high tide, you will find the going dangerously slippery owing to a slimy growth of "Blue-green Algae." Each filament of these microscopic plants is enclosed in a thick tube of mucilage, which prevents their drying up to a fatal degree between periodical wettings, which are often very distant in time from each other.

PARTIAL EPIPHYTES.

A good many plants, however, have not yet been able to separate themselves entirely from the soil, but still get the bulk of their food and water from that great storehouse while endeavouring to reach the light after the manner of true epiphytes. They have roots, often of remarkable length, which reach down from the plant above until they come into contact with the earth below. These hanging or aerial roots are another characteristic feature of our colony forests.

THE AROIDS OR ARACEAE.

One Order of Monocotyledons, the Aroids (*Araceae*) are of great interest in this connection. They may be recognised by their inflorescences, which are of the "Arum Lily" type—a cylindrical rod, or *spadix,* more or less enclosed in a green, white or brightly coloured leaf, or *spathe.* The family is a very prominent one in British Guiana, the members of it ranging from the common Water Lettuce (*Pistia stratiotes*) of our trenches through the Caladium of our gardens, with its gaily spotted leaves, the Eddoes (*Colocasia*) of our markets, the Dumb Cane (*Dieffenbachia*) of our waste lands and the *Anthurium Scherzerianum* of our ornamental pots, to the giant Monsteras which climb our trees. It is to these last that I should like to

draw your attention. Many fine specimens of *Monstera obliqua* are easily to be found in the Botanic and Promenade Gardens, their large, simple leaves with great holes in them so distinctive that the plants can hardly be mistaken. Study carefully the method of growth of the specimen you find, and especially the means by which it climbs but yet retains connection with the soil. How many kinds of root can you distinguish in this case? Make sections of them. Recall the fact that the water supply from the roots travels largely in the vessels of the wood (do you remember the experiment which shows this?) and try to explain the differences in structure which you observe in the roots of *Monstera* Compare this plant with *Anthurium gracile*, which you may find flourishing as a true epiphyte.

EVOLUTION IN EPIPHYTISM.

A quotation from Dr. Willis's book "Flowering Plants and Ferns" will be useful at this point. "The larger tropical *Araceae*," he writes, "show interesting stages in the development of epiphytism. The climbing forms grow to considerable size and form longer and longer aerial roots as they grow upwards. The original roots at the base of the stem thus become of less and less importance and it not uncommonly happens that they die away together with the lower end of the stem, so that the plant thus becomes an epiphyte. Of course, as it still obtains its water, &c. from the soil, it is not an epiphyte in the sense that *e.g.*, many Orchids or Bromeliaceae are such, and it is evident that if this method of becoming epiphytic were the only one found in the Order, these plants could with no more justice be classed as true epiphytes than the ivy which may often be seen in the 'bowls' of pollard willows in Europe, and which has got there by climbing up the trunk and dying away below. It is found, however, that some species of *Philodendron*, *Pothos*, etc., are able to *commence* life as epiphytes. The fleshy fruit is eaten by birds and the seed dropped on a lofty branch. The seedling forms clasping roots and dangling aerial roots which grow steadily down to the soil, even if it be 100 feet or more away. It is hardly possible to suppose that these true epiphytic species have been evolved in any other way than from former climbing species. The leaves of *Philodendron cannifolium*, Schott, have swollen petioles full of large inter-

cellular spaces lined with mucilage. When rain falls these become filled with water and act as storage reservoirs. Lastly, some species of *Anthurium*, etc., are true epiphytes without any connection with the soil. They have clasping roots and also absorbent roots which ramify amongst the humus collected by the plant itself. The aerial roots of some *Araceae* possess a velamen like that of Orchids." The method of seed germination high up on the branch of a tree is found also in some of our Figs in this colony. We have observed that in the bush many of the climbing Aroids have ants' nests at the base of the plant, and this must have the same result as if they took their own garden mould with them. It is worth while noticing what a very small amount of soil suffices for the nourishment of quite large plants. Of course, in the leaf-bases of Palms there is always a considerable collection, and such places often support a flourishing population, of which the fine Hare's Foot Fern—the growing end of the rhizone or root-stock bears a remarkable resemblance to the "hare's foot" of a lady's toilet table—is a prominent member; but if you keep your eyes open you will come across cases where, in the crevices of walls or the chinks of stone-work, the size of the plant seems out of all proportion to the pinch of earth which nourishes it.

(*To be Continued.*)

Interesting Papaw Experiments.

The Haiwaii Experiment Station is making attempts to secure a strain of papaya (papaw) with self-fertilising flowers, thus doing away with the necessity for male trees. The results hitherto obtained are most promising, and complete success in two or three generations is promised. Of the second generation of breeding, 454 trees examined showed 95½ per cent. with perfect flowers for fruit-bearing. One most interesting experiment was that of cutting down two male trees two feet from the ground. When the new branches came out it was found that the sex had changed, and that regular, perfect flowers, each bearing fruit, were developed :—" West India Committee Circular."

* Hints on School Gardening.

(By C. Drieberg B.A., F.H.A.S., Department of Agriculture, Ceylon.)

Objects of School Gardens:—

(a) To brighten the surroundings of the school, and make it what it ought to be, viz., a pleasant resort for the boys, and not a bare and unattractive building; (b) To lighten the routine of class work by varying it with outdoor work of a recreative nature; (c) To exemplify order, form, neatness, and good taste in the laying out of the premises; (d) To furnish a field for nature study, *i.e.*, the study of natural objects in their natural surroundings; (e) To serve as object lessons in horticulture, *i.e.*, the cultivation of useful and ornamental plants; (f) To give a practical turn to school life, and provide a training in elementary agricultural science; (g) To serve as centres for the dissemination of seeds and plants, and of information concerning them; (h) To be mediums of communication between the agencies that aim at the improvement of agriculture and the cultivating classes; (i) To induce the cultivator, directly or through the school boys, to take up new and improved products and adopt better methods of cultivation; (j) To awaken in school children a new interest in the cultivation of plants, and instil into them a love of nature, and so reconcile them to a country life, and to agricultural pursuits; (k) To encourage school children to establish gardens at their homes; (l) To make school boys take an honest pride in manual labour, and induce a healthy competition among them as well as between one school and another.

Conditions of Work.

(a) Any school which presents possibilities for school gardening will be furnished with a stock of implements, and supplied with seeds from time to time: where required, fencing wire would also be supplied; (b) Garden work should be carried on by the teacher with the help of the monitors and scholars. After setting aside

* We have much pleasure in affording our readers an opportunity of studying Mr. Drieberg's article, which appears to us the best we have yet seen on the subject.—Ed., J.B.A.

such part of the produce as is required for purposes of propagation the remainder should be divided between the headmaster, assistant master, monitors and boys who have actually assisted in the work of the garden; (c) In the case of produce not actually used as food, and which it is desirable to dispose of with a view to profit, the amount realised is to be entered in the quarterly report form. The revenue from such cultivation will at the end of the year be equally divided, half to go to the headmaster, and half to be devoted to a garden prize fund for the school; (d) quarterly reports should be furnished in the forms provided; (e) The school gardens will be inspected periodically by the Superintendent, and Inspectors, and prizes will be awarded by the Department to teachers who show the best results; (f) A certificate will accompany each prize, setting forth the nature of the award, &c., and certificates of honourable mention will also be awarded to deserving teachers.

Points to be considered in Judging.

(a) Area cultivated; (b) Situation and lay of land; (c) Climate and rainfall; (d) Number and variety of plants grown: (I) economic; (II) ornamental; (e) Laying out; (f) Arrangement of plants and trees; Grouping for effect; (h) Skill in cultivation; (i) Cleanliness of premises; (j) Cultivation in pots, tubs, and boxes; (k) Bowers and arches; (l) Fruit trees; (m) Fences and hedges; (n) Paths and drains; (o) Lawn and playground; (p) Furnishing of reports and returns; (q) School garden records; (r) Activity and intelligence of scholars; (s) Care of implements; (t) Aptitude and interest shown by teacher.

Seeds.

A certain number of hardy plants should be selected as seed-bearers. The best fruits produced by these should be taken for seed. The best seed, *i.e.*, the plumpest and heaviest should be selected, carefully and thoroughly dried and put away. Seed should be kept in tins or glass bottles with well-fitting covers or stoppers. A little napthalene or camphor put into the bottle will help to keep away insects, such as weevils, that attack seed.

Soil.

Very steep or hilly land should be laid out in terraces. Where large stones are found in the soil they should be dug

out and used for embankments or dykes—for which they always come in handy: if small and gravelly, the top soil for a foot or two should be "screened" and the gravel taken out. Where the soi is naturally poor or worn out; it must be improved by manuring. If cattle manure is not available, green manure or leaf manure can always be got. Sow green gram or some such leguminous crop once, or twice if necessary, and turn the crop into the soil. Give heavy dressings of leaf manure ("Keppitiya :" *Croton lacciferus*—or any knd of leaves which will add humus to the soil). Another good plan is to trench the land, one trench at a time, and fill the trenches with refuse vegetable matter. Wet and sour soil must be drained and given a dressing of lime. When the land becomes foul, *i.e.*, weedy and full of insects and other pests, pare and burn the upper layer.

A mulch is a dressing of anything (rotten leaves, straw, etc.,) which will act as a covering to the soil: a soil mulch, or a soil blanket is a surface layer of loose soil produced in *situ* by tillage. Mulching and tillage are recommended to fight drought.

Garden Tools.

The following is a list of implements with notes on their use:—

Alavango.—For digging holes for fence posts or for large plants; also for removing large stones, shifting logs, and breaking up hard soil.

Axe—For cutting down trees and dividing them up into sections

Bill-hook.—Used in place of a catty, for cutting branches of trees, pointing stakes, etc.

Bucket—For drawing water and conveying it from place to place.

Dutch Hoe.—A very useful implement for weeding, stirring the surface soil, and moulding up.

Fork, digging—For loosening the soil without injury to the roots of plants, particularly before applying manure.

Fork, weeding.—For removing grass and weeds and stirring up the surface soil.

Mamoty.—Used for a variety of purposes: digging, turning over the soil, weeding, levelling, drawing earth, making paths, beds, trenches, etc.

Pickaxe and *Quintannie.*—For breaking up and digging very hard soils, severing large roots, &c.

Pruning Knife.—For cutting small branches and roots.

Rake.—For breaking clods, levelling beds, collecting weeds or leaves, stones, etc.

Shears, garden.—For pruning hedges, such as Duranta and Madras Thorn

Shears, sheep.—For cutting herbaceous plant borders, such as Alternanthera.

Trowel.—For filling earth into pots and boxes, and for lifting young plants for transplanting or potting.

Watering Can.—This should only be put to its legitimate use, for watering young plants, and not for drawing water, or carrying earth and manure.

Implements should be kept by the teacher or given in charge of his assistant, or a monitor, and must not be taken for use without permission. After use, they should be thoroughly cleaned and put away in the proper place and not left lying about, as is often the case, exposed to the atmosphere. Small articles are best put away in a box or cupboard.

It will be found convenient to number each tool to correspond with the registered number in the list kept in the school This will allow of easy identification of any article lost or damaged, and also afford a means of discovering who is responsible for such loss or damage.

As soon as an implement is found to be damaged, it should not be used till repaired, as slight damage will soon result in total unserviceableness unless the article is put right at once. Teachers should as far as practicable get all

minor repairs done without troubling the Department—if possible, by the boys, in order to train them to help themselves, as well as to encourage economy and independence. Handles for mamoties and rakes should always be prepared by them; and such work should be properly finished.

—The Ceylon Agricultural Society Year Book: 1914-1915

Air For Plants.

Like all other living things, plants must breathe or they will not continue to live. The more highly specialised among them are therefore provided with elaborate respiratory systems, consisting of passages which conduct air to all parts of the plant, and openings on the surface, through which oxygen can be taken in and carbon dioxide given out, substantially as is the case with animals.

The external openings of this ventilating system are of three general types: *stomata* or valves on the surface of leaves and young shoots; *ventilating pores*, which occur in certain aerial roots; and *lenticels*, pores in the older wood, whose presence can be noted by the unaided eye in almost any plant.

—"The Tropical Agriculturist," (Ceylon),
February, 1916, No. 2.

Vegetable Paint.

In certain parts of Uruguay the farm buildings are a fine white colour, even during the wet season. To obtain this neat effect a white-wash is used, made from the sliced "leaves" of the Prickly Pear, which, when macerated in water for twenty-four hours, produce a solution of creamy consistence. To this lime is added and well mixed in. When the solution is applied to any surface, be it wood, brick, iron, or other material, a beautiful pearly white appearance is produced, which endures through rains and frosts for many years.

"The Tropical Agriculturist," (Ceylon),
February, 1916.

The Birds of British Guiana.

(*By Charles B. Dawson, S.J., M.A., Oxon.*)

IV.

DOVES AND PIGEONS.

Pigeons form a homogeneous Order, comprising five families, seven sub-families, ninety genera and some six hundred species. The use of the name pigeon or dove is a matter of choice. The common domestic pigeon may be taken as the type although certain ground doves are only a quarter the size, while the *Gouridae* or Crowned Pigeons of New Guinea are as large as a bush turkey. The Order includes the large tooth-billed pigeon of the Samoan Islands (*Didunculus strigirostris*) as also the three species of the now extinct Dodo, (*Dididae*.)

The following characteristics may be noted:—the body compact, the feathers close, the head small, the neck dainty; the bill slender, the base with the nostrils being fleshy; feet small and often pink in colour, the bird walking lightly on its toes. The coloration is ordinarily sober, grey-blues and browns being the prevailing hues; but the fruit-pigeons of the Old World may be brilliant green, with a coppery sheen and markings of various colours. There is a general tendency to bars on the wings or jottings of dark purple or black; there are often green or purple reflections on the neck, as well as a ring more or less defined round the throat.

Pigeons build as a nest a mere raft of sticks through which the two white eggs may sometimes appear; or like the Stock-dove, they may make a nest in the hole of a tree or rock. They feed their young on a cheesy secretion of the crop, the young birds putting their beaks into the mouths of their parents.

Pigeons feed in company; often in immense flocks: Fruit-pigeons on trees, others on the ground. Grain of all kinds, with occasional insects and their larvae, ants' eggs, and even snails, form their staple food. Fruit pigeons feed as their name indicates.

PIGEONS & DOVES—(Colonial). *Columbidae.*

Speckled Pigeon	*Columba speciosa.*
Common "	" *rufina.*
White-naped Pigeon	" *albilinea.*
Copper-coloured "	" *plumbea.*

Peristeridae.

Bronze-necked Ground Dove	*Zenaida vinaceo-rufa.*
Speckled Ground Dove	*Chamaepelia passerina.*
Common " " (small)	" *minuta.*
Savannah " " (red)	" *talpacoti.*
Grey " "	*Peristera cinerea.*
Rust-coloured " "	*Leptoptila verreauxi.*
Common Ground Pigeon (red-under-wing)	" *rufaxilla.*
Brown Ground Pigeon (Mountain Ground-dove)	*Geotrygon montana.*

PARTRIDGES.

Pheasants, Grouse, Partridges, Quails, Fowls and *Peacocks* are included in the same sub-order *Phasiani.* The sub-order includes no less than seventy-seven genera and some four hundred and ninety species, nearly all belonging to the Old World. Only two representatives are found in the colony, both belonging to a family called *Odontophoridae,* or American Partridges. They may be recognized by the double-toothed mandible, and the absence of spurs. They are quail-like birds of small size, and in habits resemble their European congeners to some extent, being found in coveys in open woods and pastures, though they will take refuge in trees, crouching along the branches. Their food consists of shoots, seeds and berries, and also insects. The nest is formed on the ground, and in it are laid white or drab eggs.

Odontophoridae—(Colonial.)

Quail-Partridge	*Eupsychortyx sonnini.*
Duraquara (or Guiana Partridge)	*Odontophorus guianensis.*

TINAMOUS.

Tinamous or ***Maams*** (as they are locally called), are the survival of an ancient form; there are nine genera and

sixty-nine species, all peculiar to the Neo-Tropical and Neo-Subtropical regions. In outward appearance they resemble Partridges, but in their internal structure they have affinities with the Ostrich, the Apteryx and certain now extinct forms. The colour of the different species varies from rufous brown to slaty, with bars or half-moons of a darker shade above, or even below: the under parts being lighter, with grey or whitish throat and vent. The beak, it will be noticed, is longer than that of Partridges; it is, in fact, much like that of the Rhea. They have small, triangular tongues, a large crop, powder-down patches near the rump, and only a rudimentary tail. They are ground feeders, but are strong in flight, dashing blindly ahead when, with difficulty, they are disturbed. They scrape a hole for their nest and lay eggs varying from reddish-chocolate to dark blue or purple; these have a surface like polished porcelain, unlike those of any other bird. As in Ostriches and *Ratitae* generally, the male takes upon himself the duty of incubation. The sexes are much alike, the female, if anything, being larger. The species vary in size, some being no larger than a Quail, others, the size of a Fowl. The note is often a shrill whistle. The food consists of seeds, fruits, and insects. They dust themselves like Fowls. They often form into coveys, frequenting the dense undergrowth of the forest or the open country. The flesh is excellent eating.

TINAMOUS—(Colonial). *Tinamidae.*

Large Maam	*Tinamus subcristatus.*	
Brown Maam (hiding)	*Crypturus cinereus.*	
†Capped Maam (or small Maam)	,,	*pileatus.*
†Olive-brown Maam	,,	*simplex.*
†Red-footed ,,	,,	*erythropus.*
Small Maam (spotted)	,,	*variegatus.*
*Brown-breasted Maam	,,	*dissimilis.*

CURASSOWS & MARUDIS.

Under the family *Cracidae* are included *Curassows* or Powis Birds and *Marudis* or Bush Turkeys as well as *Ortalis* or Bush Fowls. They number eleven genera and fifty-nine species and all belong to the New World.

Curassows are handsome birds, standing from three to four feet high. *Crax alector*, the one commonly domesticated, may be taken as the type. The prevailing colour is glossy black with pure white or light-coloured vent. The base of the beak is bright yellow in *Alector* and others, and scarlet in *Uritu uritu*, *Nothocrax*, and some others. There is a curly crest, sometimes tipped with white or yellow. The females are smaller and are, in some cases, marked or mottled, the colouring being duller. Nothocrax is chestnut above lined with black, and cinnamon below; the crest is black, the beak scarlet, the feet flesh-coloured. Bush Turkeys or Marudis are, in outward appearance, more like the Mound-makers or Bush Turkeys of Australia than Curassows; their habits, however, are similar to the latter and thus they are placed in the same family. Mound-makers (*Megapodiidae*) are closely related to *Cracidae*, but are not arboreal in their habits The Hunaqua, so named from its cry, is an earth-brown bird, hardly the size of a domestic Fowl, the top of the head being red, and there being a small red wattle below the beak. It is easily tamed.

Bush Turkeys are brown or olive-green, varied with red; the throat is wattled, the naked skin of the face may be purple or blue, the crest moderate. Ortalis is brown or greenish with no metallic lustre, the under parts being lighter: white or buff; the naked skin red, the feet pink.

Cracidae are forest-dwellers, feeding on leaves and fruit; some species scratch the ground for food like Fowls. They make large, careless, nests and lay comparatively small white eggs. Their flight is generally heavy; their note may be loud and harsh or cackling.

CRACIDAE.—(Colonial.)

Common Powis Bird	*Crax alector.*
*†Black-crested Powis Bird	*Nothocrax urumutum.*
*†Red-billed „ „	*Mitua mitu.*
Savannah „ „	„ *tomentosa.*
†Knob-fronted (red-billed) (?)	*Pauxis pauxi.*
Small Marudi	*Penelope jacupeba.*
Large „	„ *marail.*
Green „	„ *jacucaca.*
Hanaqua „	*Ortalis mot-mot.*
White-headed Marudi	*Pipile cumanensis.*

THE HOACTZIN.

The *Hoactzin* (Hoatzin or Hoazin) or *Canje Pheasant* differs from all other birds in its internal structure and is therefore placed in an Order by itself. It has an abnormally large crop, and to accommodate this, the breast-bone keel is aborted in the front: a form unlike that of any other bird. It derives its local name from the Canje Creek where it is found in fairly large numbers, and from its fancied resemblance to a Pheasant. Its long, loose, crest of heckled rufous feathers, suggestive of "flowing hair behind," provides its generic and family name, also that of the Order, *Opisthocomiformes*. It is generally placed between Pigeons and Rails, though it has no strong affinities to either. It is never seen far from the dense shrubberies of the creek-side where it makes its home, feeding on the leaves of the Bundoree Pimpler and other water-side trees.* It flies lazily from tree to tree and in alighting will hold up its wings for some little time, as if uncertain of its art; it will then rest upon its breast bone, the skin being worn bare. The feathers of the breast are hair-like; the bare patch around the eye is blue; the iris red. The young, which run about as soon as they are hatched, have two claws on the wings (that is, on the index and pollux), with which they climb about with great agility. A conspicuous nest of sticks is made in which are laid about five eggs of a creamy pink with blotches of red and purple. The sexes are alike; a cock and several hens are commonly found together. Its note is a harsh, husky hiss, unlike that of a bird. It has a slight musky odour. It is a very local bird, being found only on the Amazon, in this Colony, Colombia, Ecuador, Peru and Bolivia.

Order : *Opisthocomiformes.*
Sub-Order : *Opisthocomi.*

Family : *Opisthocomidae.*

Hoactzin, Canje Pheasant or "Anna" — *Opisthocomus cristatus* or *hoazin.*

*The precise food-plants of the Hoactzin are now being investigated.

RAILS, CRAKES, COOTS, MOOR-HENS, AND FINFOOTS.

These birds form an order which has representatives in nearly all parts of the world. There are in all fifty-three genera and some two hundred and seven species, of which fifty belong to the New World. They vary in size, some being little larger than a sparrow, others the size of a hen. General characteristics are: small head, short beak, sometimes thickened at the base, or broadened into a frontal shield which may be white or sealing-wax red; the body compressed and lithe, the feathers smooth, the legs long and slender, the toes also abnormally long in many cases, or partly webbed in fin-foots, tail short. The coloration is generally sober—olive-browns, and bluish greys being the prevailing tints, with markings of black and white,—and the thighs are sometimes striped with black and white; there are exceptions, as for instance, *Porphyriola martinica*, which is a gorgeous purple blue.

They inhabit for the most part, the tangled underwood, generally in damp situations near creeks, and are expert in making their way through dense masses of roots and branches. Their food consists of worms, molluscs, insects, the shoots and roots of aquatic plants, and seeds. Their nests may be masses of plants floating near the water's edge or among sedges. From two to ten eggs are laid, and they are often pink or cream coloured, with spots or blotches of red and purple.

Some are almost silent birds; others make weird sounds like the croaking of frogs or the muffled barking of a dog, others again cackle, or make loud whistling noises. They swim and dive with dexterity and seldom take wing.

GREBES.

Rallidae—(Colonial).

Long-billed Rail	*Rallus longirostris.*
Virginian "	" *virginianus.*
Brown-headed Gallinule	*Aramides axillaris.*
Red-breasted " (Killicow)	" *cayanea.*

Chestnut Rail	*Amaurolimnas concolor.*
White-necked Crake	*Porzana albicollis.*
†Eye-spotted Rail	*Thyrorhina schomburgki.*
Little Rail (yellow-vented)	„ *flaviventris.*
Red-fronted „	*Creciscus cayennensis.*
Red-faced „	*Néocrex erythrops.*
Coot	*Gallinula galeata.*
Purple Coot (Blue breasted Water hen)	*Porphyriola martinica.*
Small Moor-Hen	„ *parva.*

Heliornithidae.

American Fin-foot	*Heliornis fulica.*

GREBES.

Grebes belong to an ancient form of which five genera, including twenty-five species, survive. Representatives are found in most parts of the world, nine in America. They are all water birds with webbed or lobed feet, and the legs placed far back. They are generally a dusky black or brown above and silvery white below. Some species have fantastic crests or ears, or ruffs of feathers on the head. Their plumage is short and close, as befitting their aquatic life. They feed on fish, molluscs, reptiles, crustaceans, the shoots of aquatic plants, and insects. Their nests are huge floating masses of aquatic plants; the eggs are chalky and white or bluish in colour, but soon become stained brown from the weeds the parent bird places upon them when the nest is left. Though they do not easily take wing, they will fly great distances, being migratory birds. The chicks run about as soon as they are hatched, using both wings and legs almost like mammals. The colony possesses one species only.

GREBES.—(Colonial) *Podicipediae.*

†Pied-billed or Fetter-footed Grebe	*Podilymbus podicipes.*

PLOVERS & CURLEWS.

Within the Order *Charadriiformes* are included *Plovers, Curlews, Woodcocks, Snipe, Sandpipers, Lapwings, Turnstones, Ruffs, Oyster-catchers, Stilts, Stints, Phalaropes, Dunlins, Mots, Redshanks, Greenshanks, Godwits, Wry-*

bills, Avocets, Seed-snipes, and the long-toed *Jaçanas* or *Spur-wings.* There are in all some one hundred and fifteen genera, including no less than three hundred and seventy odd species, of which some seventy species are found in the New World.

The Order is very heterogeneous but all agree in having long, slender legs on which they can run with great swiftness, and short tails. Lapwings, however, are often in flight, and Phalaropes have their feet somewhat modified for swimming. Many Plovers and Curlews love dry inland places, whereas Turnstones, Oyster-catchers, Godwits, Wrybills, and Avocets are to be found on the sea-shore. Woodcocks are found in forests, snipe in marshy places; Sandpipers are known all over the world and as far north as Greenland; there is hardly a strip of sound by river or sea that has not its Sandpiper. Jaçanas run about the floating leaves of lilies or other water plants, aided by their abnormally long toes.

These birds have generally slender bills, soft at least at the base; in Curlews it is very long and curved; in Wrybills it is curiously turned to one side; in the Avocet turned upwards. The plumage is generally brown or grey, white or lighter colour below and often marked or barred with a darker colour. In some species, as for instance Oyster-catchers and Stilts, it is glossy black above and white below, the bill and the legs being often bright red, as well as the iris. Some genera have entirely different plumage for the pairing or nesting season, particularly Phalaropes and Ruffs; thus the grey Phalarope of England, where it winters, is the Red Phalarope of the Continent. The sexes are generally similar but in *Eudromias morinellus* and *Phalaropus hyperboreas* at least, the females are brighter in colour than the males, which take upon themselves the burthen of incubation. Several genera, notably the *Parridae,* have a carpal spur which may be large and stout. The eggs are generally pear-shaped; they vary in colour from olive green to drab, sometimes white, with blottings and marking of black or lighter shade; the nest is generally placed

on the ground; the eggs, with their pointed ends towards the centre, are difficult tto distinguish from the surrounding stones. Their note varies from the drumming of the snipe to the screaming of the oyster-catcher and the metallic rattle of the spur-wing. Many of them have a wide range, being migratory. Their food consists of crustaceans, insects, worms, molluses, and sometimes berries and vegetable matter.

PLOVERS, *Curlews*, Etc.--(Colonial.) *Charadriidae.*

Turnstone	*Arenaria interpres.*
Spur-winged Plover	*Hoploxypterus cayanus.*
Black-breasted Lapwing	*Belonopterus cayennensis.*
Grey Plover	*Squatarola helvetica.*
American Golden Plover	*Charadrius dominicus.*
†Semi-web-footed Shore "	*Ægialeus semiualmatus.*
Coloured Sand "	
Larger Curlew	*Numerius hudsonicus.*
Snowy Sand Plover (?)	" *nivosa.*
American Stilt	*Himantopus himantopus.*
*American Avocet	*Recurvirostra americana.*
Larger Curlew	*Numenius hudsonicus.*
Eskimo " (?)	" *borealis.*
American Dodwit (?)	*Limosa hudsonica.*
*Dowitcher "	*Macrorhamphus griseus.*
Stilt Sandpiper	*Micropalama himantopus*
Willet or Stone-Curlew	*Symphemia semipalmatu*
Larger Yellow-shanks	*Totanus melanoleucus.*
Lesser " "	" *borealis.*
†Marsh Sandpiper	*Helodromas solitarius.*
Spotted "	*Trinfoides macularius.*
Longtailed "	*Bartramia longicauda.*
Semi-web-footed Sandpiper (or Peep)	*Ereunctes pusillus.*
Red-necked Sandpiper (?)	*Tryngites subruficollis.*
Sanderling	*Calidris arenaria.*
†Spotted-necked Sandpiper	*Heteropygia maculata.*
*Brown-tailed "	" *bairdi.*
Dusky-necked "	" *fuscicollis.*
The Knob	*Tringa canutus.*

Common American Snipe	*Gallinago frenata.*
Great " "	" *undulata.*
Two-Striped Thick-Knee	*Œdicnemus bistriatus.*

Parridae. (Colonial.)

Common Jaçana or Spur-wing		*Jaçana jaçana.*
†Darker Jaçana or Spur-wing	(?)	" *melanopygia.*
Black Jaçana or Spur-wing	(?)	" *nigra.*

CRANES.

Cranes belong to an old form and chiefly to what we call the Old World. The American representatives of the Order cannot be called typical. There are in all some sixteen genera with thirty-four species, five genera including fourteen species being peculiar to the New World.

Cranes include the largest forms of wading birds and are distinguished by their long legs, moderate beaks and generally short tails; several species have crowns or crests, flowing feathers and other adornments. They perform strange antics during courtship: bowing, dancing, scraping, and jumping in the air; sometimes they will toss leaves or twigs into the air catching them again as they descend. They are said to pair for life, remaining faithful to each other during their long migratory flights. They are known for their loud, piercing, whooping or trumpeting noises, which they utter with head thrown back and mouth agape. They feed on grain, pulse, shoots, tubers, as also small mammals, reptiles, insects and even fish. They nest in marshes or merely scrape a hole in the ground; the eggs may be brown or buff with markings of a darker colour or purple.

Trumpet Birds are small cranes with many of the habits of their larger congeners. Of these there are seven species all peculiar to South America. These are skittish birds and make amusing pets. They make low ventriloquistic noises, hardly to be called trumpeting. The sexes are similar. At certain seasons they flock together as all cranes do; they build their nests on the ground, laying white or creamy eggs.

The *Caraow* is a connecting link between cranes and herons as regards external appearance, having a long bill; but internally it resembles the rails. There are two species, one of which is found in the Colony. They frequent the shallows of streams and marshes and feed on mulluses and worms. They build their nest among reeds and lay some twelve pale brown eggs mottled with purple. Their note is a loud melancholy wail, or sometimes a cluck.

Sun-bitterns are not crane-like in outward appearance, and there has been some difficulty in assigning them their present status. They are not bitterns, as was formerly supposed. They have a curious habit of spreading out their wings to form a circle, the primaries almost meeting in front, giving a fanciful resemblance to the setting sun. They walk with slow and dignified step, keeping the body horizontal and stretching out the neck. They are adept at catching flies and other insects. They may be found on the muddy banks of rivers feeding on fish and insects. The note is a long drawn whistle. They build their nests on low bushes and lay reddish eggs with brown and grey markings. They are easily tamed and have nested in the London Zoological Gardens. There are only two species in the genus.

CRANES. (*Colonial*).—*Aramidae.*

Snipe-like Caraow	*Aramus scolopaceus.*

Psophiidae. (Colonial.)

Guiana Trumpet Bird (or Warracaba)	*Psophia crepitans.*

Eurypygidae. (Colonial.)

Sun-Crane (or Bittern)	*Eurypyga helias.*

STORKS, HERONS AND IBISES.

These birds may easily be recognised by their long, straight, stout, pointed, and powerful beaks, long necks, and long legs. Storks in appearance are like large herons, but differ in several important respects. In the same order, *Ardeiformes,* are included *Ibises* and *Spoonbills. Bitterns, Ægrets, Quacks, Gauldings,* etc., are all herons.

This Order includes some seventy genera with two hundred and sixty-five species, of which only some forty species are found in the New World.

All these birds are waders in the truest sense, seeking their food, which consists of fish, crustaceous, molluscs, etc., in the shallows Storks add to their menu frogs and snakes; Ibises, beetles and other insects. The prevailing colour of Storks is white, the primaries being often black, the beak and legs red. The *Negro Cop* or *Jabiru* has a black head, beak, throat and legs: the *Pelican Stork* or *Nigger-head*, a black beak, throat, and legs, as also the flight feathers. The sexes are similar. They build their nests, sometimes immense structures, on high trees or flat tops of rocks. In Europe, the presence of the Stork used to be regarded as a lucky omen, and flat-topped pillars or chimneys were often erected to accommodate them, the birds taking to them quite naturally. Theireggs are whiteand chalky Having no vocal chords, the only noise they make is a hiss, or a clattering of their bills.

Herons are much smaller birds and shyer. They flock together in their roosting places, but feed in solitude, remaining for long periods in the same place and attitude watching for their prey. Like Storks, they seldom or never take to the water by swimming.

White, grey, or buff are the prevailing colours, with markings of black; some species are adorned with a black crest that hangs down the back like a pigtail. Bitterns may be brown, or reddish, sometimes rich chocolate with green, striped, spotted or lined. The neck is in some forms adored with a frill or mane.

White Ægrets are indispensable in rice fields, keeping them fairly clear of crustaceans, insects and other creatures destructive to the grain or young plants. Unfortunately in recent years thousands of these most useful birds have been slaughtered, and that in the nesting season, to supply the market with "osprey-plumes" which at this period adorn the wings of the male birds.

Night Herons, as their name implies, carry on their useful operations at dusk or dawn, and perhaps during most of the night. Bitterns have the same habits. The

note of herons is harsh and guttural, hence such local names as 'Quaak' or 'Chow.' Bitterns, during the nesting season make a booming or bellowing noise, from which some would derive their name. They have a habit, when alarmed, of standing with vertical beak, and thus approaching the intruder will suddenly deliver a jab with this powerful weapon that may result in the loss of an eye.

Herons, unlike most other birds (not excluding Famingoes) fly with the head drawn back upon the body. The nest may be made on trees or among the reeds of marshy places, from which they are never far distant. They lay some six eggs of bluish or greenish white. Ibises are easily distinguished by their weaker bills, which are almost semi-circular. *Tantulus* (with a straight beak) forms a connecting link, and is sometimes called an Ibis. Among these birds, the Scarlet Ibis is remarkable for its flaming red colour, unsurpassed in beauty by any other. The young are a dull brown A flock of these birds is a sight never to be forgotten. The Ibis was regarded as a sacred bird among the ancient Egyptians and bears the name, in lower Egypt, of "Father of the Sickle" from the shape of its beak. Other species are white or brown, glossed with green or purple ; the bill and feet are generally black. Some species are adorned with a head plume.

Spoonbills, of which there are three genera including six species, have a representative in each quarter of the globe. The disc at the end of the mandibles marks them out from all other birds. They are to be found at the mouths of rivers or in marshes or lagoons near the sea. As they move along the shallows feeding, they swing the bill with a semi-circular motion from side to side searching the mud for their prey. Several species wear a nuchal crest, at least during the nesting season. They nest in colonies among reeds or low bushes and lay four or five dull white eggs spotted with red. Their note is harsh and guttural: like storks they have a habit of clattering their bill. All these birds have powder-down patches.

STORKS AND HERONS.—(Colonial.) *Ardeidae.*

Large Blue Heron	*Ardea cocoi.*
„ White Ægret	*Herodias egretta.*
Blue Gaulding	*Florida caerulea.*
Small White Ægret	*Leucophoyx candidissima.*
Blue Quaak	*Nyctanassa violocea.*
†Red or Agami Heron (Solitary)	*Agamia agami.*
Common Quaak	*Nycticorax nycticorax.*
Boat-Bill	*Canchroma cochlearia.*
Crested Gaulding	*Piicrodius pilcatus.*
Shypook (hawk-like striped)	*Butorides striata.*
Tiger Bittern	*Tigrisoma lineatum.*
Small Heron	*Zebrilus pumpilus.*
†Small Zebra or Tiger Heron	*Zebrilus pumiles.*
†Brown-winged Bittern (or small Tiger-bird)	*Botaurus pinnatus.*
†Freckled Bittern	„ *lentiginosus.*

Ciconiae.

Pelican Stork or Nigger Head	*Tantulus loculator.*
Heeri Stork	*Euxenura maguari.*
Negro-Cop	*Mycteria americana.*

IBISES.—(Colonial.) *Ibididae.*

White-necked Ibis	*Theristicus caudatus.*
Bush Ibis	*Harpiprion cayennensis.*
*†Pin-tailed Ibis	*Cercibis oxycerca.*
Scarlet Ibis (or Curry-curry)	*Eudocimus ruber.*

SPOON BILLS.—(Colonial.) *Plataleidae.*

†Roseate Spoon-bill	*Ajaja ajaja.*

FLAMINGOES.

The *Flamingo* differs from all other wading birds in having webbed feet, and from all other birds whatever in having a moveable maxilla and a practically immovable mandible. The reason for this curious formation of the

beak is this: having such long legs, and obtaining its food by sifting the mud through its beak as ducks do, it finds it more convenient to feed with the head inverted, the maxilla thus taking the place of the mandible and *vice versâ.* The flamingo is recognized as a link between storks and geese, and is placed in a separate order, *Phoenicopteriformes.* There are three surviving genera with six species, distributed in various parts of the world. As the name implies, they are all, more or less, of a flaming red colour.

Like ducks and geese, Flamingoes simultaneously shed all their flight feathers in the Autumn and are, during this period, unable to fly. They fly well, however, when they take to wing, with head and legs stretched out; and the flock generally forms the letter V as the birds fly on high to pastures new. Their favourite haunts are salt lakes; here they will scrape together the mud and make their cone-shaped nests, laying two eggs with a bluish, chalky, shell. The young run about as soon as they are hatched. They feed like ducks on aquatic herbage, frogs, molluscs, etc., and cackle like geese.

FLAMINGOES.—(Colonial.) *Phoenicopteridae.*

Flamingo *Phoenicopterus ruber.*

SCREAMERS, DUCKS AND GEESE.

Ducks, and *Geese,* with *Mergansers, Goosanders* and *Swans* from a definitely marked order, *Anseriformes,* of which seventy genera and some two hundred species are known to Science. Later Orinthologists also include *Screamers* or *Chakàs,* regarding them as the ancestors of the whole tribe, though outwardly unlike all other members of the order, having fowl-like beaks and only slightly webbed feet. Screamers are peculiar to Neo-tropical regions, inhabiting marshes and feeding upon water plants, seeds, etc. There are three species only, one of which is found in the colony. The general coloration is greyish black above and lighter, or even white, below. In *Palamedea cornuta,* the Guiana species, the lores are feathered and a slender, whitish caruncle adorns the forehead: in *chavaria* and *cristata* a crest finishes off the back of the head—in *chavaria,* the lores are naked and pink in colour, the beak

and legs red. *Chauna cristata* is the largest of the family, being the size of a very large turkey. All are armed with sharp spurs, two on the carpal or "butt" of each wing. Between the skin and the muscles is a layer of air-cells, which causes a crackling sound when the body is pressed. The name is derived from its loud cry which, uttered with the head thrown back, can be heard for a distance of two miles. These birds have the habit of soaring to great heights and then wheeling in circles, uttering at the same time "cha-ha" or "cha-ha-li," hence their local name. The nest is a huge mass of reeds standing or floating in the water, and herein four or six buff-white eggs are deposited. Ducks. geese, and swans are all characterized by having broad, blunt, flat, beaks with well-developed tooth-like edges, and sometimes adorned at the base by a caruncular knob, and armed at the end by a bony process called the "nail" They feed upon grass, grass-wrack, and other aquatic plants, shoots, and roots; also upon beetles and their larvae, the latter of which they obtain by sifting the mud. (where the water is shallow enough), through their beaks, and half-submerging their bodies in the process; the serrated beak acting as an excellent sifting, pulling, and grasping instrument.

Swans are distinguished from ducks and geese by their longer necks and more graceful forms. The one usually domesticated is *Cygnus olor,* the Mute Swan, found in a wild state in N. and C. Europe and Asia, N.W. India and on the Caspian and Medeterranean in the winter. It is still considered a royal bird in England and well deserves the title; for when, with arched neck and wings puffed out like sails, it ploughs the waters of some broad lake, no more majestic sight in bird life can well be imagined. Its only note is a hiss or grunt, hence its name. Other swans, however, have trumpet-like or whistling notes. Of the eight species all are snow-white, with the exception of *Chenopsis atrata*, found in Tasmania and Australia which is black, and *Cygnus melanocoryphus* found in Brazil and Patagonia, which has a black head and neck. The sexes are similar; the nest is a pile of herbage near the water; the eggs, four or five in number may be white or light green. They are generally found in pairs and do not congregate.

Geese are stouter and coarser birds with harsh voices, and are often found in flocks. The prevailing colours are grey, brown, or black, often lighter below. The sexes are similar Neither swans nor geese are found in this Colony. There are some twelve genera with thirty species of these birds.

Ducks are by far the most numerous forms of the order, but smallest in size, though our *Cairina moschata* or Musky Duck (erroneously called "Muscovy") attains the size of some of the small geese. The common Bahama Duck (sometimes erroneously called "Vicissi") may be taken as a type though it differs from most in the important respect that the sexes are similar. In most forms, the drake is much the finer bird, being in many cases most gaudily coloured during the nesting period, while the female remains dull. Many drakes also have crests, or face feathers, heckled or elongated scapulars, ruffs or curly tails. In this Colony, however, we have no highly coloured duck. Ducks congregate in flocks, sometimes in immense numbers, but pair off and separate for nesting purposes. They are only polygamous under domestication. The nest is formed in some secluded spot under a tree or bush and not always near the water; when incubation begins the female lines the nest with down from her own breast and carefully covers the eggs when she leaves. The eggs, upwards of a dozen in number, may be white, or buff, or green respectively. Tree ducks roost and build in trees, but how they conduct the ducklings to the water is as yet unknown.

Characteristic of many ducks in the "speculum" or broad band of glossy green or blue or some other colour upon the wing. In the Autumn ducks shed their quill feathers simultaneously and are thus rendered incapable of flight; they then retire in flocks to marshy fastnesses. Some species are almost mute, others give vent to their feelings in noisy quackings; others again are whistlers.

SCREAMERS.—(Colonial.) *Palamedcidae.*

Horned Screamer	*Palamedea cornuta.*

DUCKS.—(Colonial.) *Anatinae.*

Musky (or Muscovy) Duck	*Cairina moschata.*
White-faced Vicissi Tree-duck	*Dendrocygna viduata.*

Brown Vicissi Tree-duck		*Dendrocygna fulva.*
Common or Two-colour Tree-duck		„ *discolor.*
†Green-winged Teal		*Nettium brasiliense.*
Black-winged Pintail	(?)	*Dafila spinicauda.*
Bahama Duck (spotted breasted)		*Poecilonetta bahamensis.*
Blue-winged Teal		*Querquedula cyanoptera.*
Black-tailed "		„ *discors.*
	(?)	*Metopiana peposaca.*
Spiny-tailed Duck		*Nomonyx dominicus.*

CORMORANTS AND PELICANS.

In the Order *Ciconiiformes*, or according to other ornithologists, *Pelecaniformes*, are included *Cormorants, Ducklars, Gannets, Frigate Birds, Tropic Birds* and *Pelicans.* The Colony possesses one species of these several families. There are in all seven genera and seventy-five species, of which forty-one are cormorants, four ducklars, eleven gannets, two frigate birds, six Tropic birds, and ten pelicans. Their affinities are determined by their internal structure; externally, they are very heterogeneous. All are water birds feeding on fish, and have webbed feet; Cormorants have the four toes connected by a web. Cormorants are further distinguished by having, when adult, no external nostril. They are large birds almost the size of a goose; the Green Cormorant or Shag is somewhat smaller. Cormorants live on the rocks by the sea shore; they are expert divers and pursue fish in their native element with great dexterity. Formerly, being easily tamed, they were used as fishers, a band being put around their throat to prevent them swallowing their captures. The "Master of the Cormorants" was once the title of one of the officers of the English Royal Household. Cormorants breed in communities on preciptious rocks or trees; a huge mass of sea-weed forms the nest in which four small bluish white eggs, with a thick, soft, shell are deposited. The prevailing colour is black or dark brown with different degrees of glossiness; the under parts may be white, and there may be patches of white on the face. The beak is long and hooked, the throat is dilateable, forming a pouch. There may be bare patches in the face or throat, red or yellow respectively; some species are adorned with a crest; the

feathers on head and throat may be hair-like. Their note is a croak or a hiss.

Darters, Ducklars, or Snake-birds, as they are variously called, are the Cormorants of rivers. They are distinguished by their snake-like necks, pointed beaks, and broad tails, the long feathers of which are curiously fluted transversely. Like Cormorants they are skilful divers and like them use both feet and wings when under water; devouring one fish after another while under the surface and sometimes appearing with their head alone above it, giving them the appearance of a water snake. The 8th and 9th vertebrae of the neck are modified in a manner unique, enabling the bird to seize its prey with lightning-like rapidity, and giving the neck a Z shape. The general coloration is glossy black, the African and Australian species having patches of rufous on head and wings. The Colony species resembles that of India. The male in courting plumage is a beautiful object: the eye is bright crimson, the bare skin of the orbit green, that of the chin orange; along each side of the neck are feather filaments of white tinged with purple; other elongated, heckled, scapular feathers are centred with silky-white. The head, neck and breast of the female are dull brownish or grey. The nest is built in a high tree over water, of sticks lined with leaves, and may be used several years in succession; several nests may be found in close proximity. The eggs are like those of Cormorants.

The *Gannet* or *Solan Goose* is a goose-like bird with pointed beak, wings and tail. The general coloration is white or grey-brown with white markings or patches; the primaries may be black. There are bare patches on the face or throat of bluish or reddish colour; the bill may be yellow; the feet, yellow or reddish. They resemble gulls in their habits, being ocean birds and feeding on surface-swimming fish, squids, etc. They make their huge nests on rocks, and lay two greenish or bluish eggs with chalky surfaces. Some of the birds are extraordinarily fearless and have earned the sobriquet of "Booby." The note is a harsh, repeated cry.

Frigate or *Man-of-War Birds* are so named from their habit of cruising about and chasing other birds such as Terns or Boobies, and compelling them, should they have

caught a fish, to drop their booty, which they seize before it reaches the water. They are expert in suddenly turning or twisting about in flight, and have a power, unrivalled by any other birds, of soaring and of making quick progress with apparently motionless outspread wings. The wings are long and pointed, and the tail is deeply forked; and thi: latter they open and shut, like a pair of scissors, as they fly. The coloration is blackish-brown with a green and purple sheen. The female is brown above and white below. She has pink feet whereas the male has black. He is also adorned with a scarlet pouch which he inflates in flight; the naked orbits are also scarlet. They seldom approach the shore except to nest; the nests being built of twigs or trees and the one egg is like that of Cormorants. All these birds feed their young by regurgitation.

Tropic—or *Boatswain—birds* like the foregoing are denizens of the ocean, seldom approaching land except for breeding purposes. They make no nest but lay one brownish egg, spotted with darker colour, in some hole of the rock. The colour of all Tropic-birds is glossy-white with markings of black about the eye. The beak is red except in *flavirostris*, and in *rubricauda* the two long, middle tail-feathers are also red-crimson; *aetherus* has the upper part of the body barred with black. Several of the species are tinged with pink. The sexes are alike. Unlike Frigate-birds they fly with rapid pulsations of the wings and often dive into the water from a great height. Ships seem to attract them; they will circle round and even perch upon the rigging The feet are generally black, and the legs so short that can only when difficulty rise from a level surface. Their ordinary note is a croak; but parents when disturbed in the nest will scream and chatter, viciously snapping at the intruder. They are so called because they are seldom or never found outside the Tropics. *Ph. flavirostris*, the smallest of the family is only the size of a large pigeon.

Pelicans may at once be recognised by the enormously dilatable pouch formed by the skin between the lower jaws of their long beak. Of the size of a goose and goose-like in appearance, the general coloration is white, sometimes with a tinge of rosè or yellow, the primaries being sometimes black. The species found in the Colony, however, is brown and unadorned. Several species have nuptial crests

and head filaments and long, heckled scapular feathers. The naked patches of the face may be yellow marked with red, the feet pinkish. Some species have a blood-red knob at the end of the beak from which may have arisen the legent, famous in ecclesiastical art, of the Pelican feeding its young on its own blood. The Pelican swims and dives with ease, securing many fish in its pouch before eating them at its leisure. Their habitat is the shore of tidal waters and inland lakes and marshes. The nest may be simply on the ground, or built of sticks in trees; two or three eggs, white or bluish and with chalky incrustations, are laid, and the young are fed with partly digested fish. The sexes are similar. Though built so heavily, pelicans fly well and swiftly with the head drawn back on the body as with herons. The legs are short and the walk is waddling; they take wing with difficulty from the ground.

CORMORANTS AND PELICANS.—(Colonial.) *Phalacrocoracidae.*

The Colony Cormorant *Phalacrocorax vigna.*

Plotidae—

The American Ducklar *Plotus anhinga.*

Sulidae—

†Aquiline Frigate-bird *Fregata aquila.*
Brown Gannet *Sula sula.*

Phaethontdae—

American Tropic-bird (?) *Phaethon americanus.*

Pelecanidae—

Brown Pelican.
Red-billed „ (?) „ *erythrorhynchus.*

GULLS AND TERNS.

With *Gulls* and *Terns*, in the Order *Lariformes*, are also associated *Skuas* and *Skimmers*, all of which are sea-birds, seldom visiting the land except for nesting purposes. Some ornithologists also include *Puffins, Auks,* and *Guillemots,* these latter, however, are more strictly sea-shore birds and differ from the former in several particulars. The former group have long, pointed wings, and are remarkable for their enduring flight; the latter have rounded wings and fly somewhat heavily near the surface of the water when

they fly at all; but they are expert swimmers and divers. In the latter group also, the legs are placed far back so that the birds sit in an upright position. The normal colour of Gulls is white or grey with black markings or patches Terns or Sea-swallows may generally be distinguished by their forked tails, they are generally grey above and white beneath with black or brown markings; their feet are webbed and generally a light vermillion in colour, whereas the feet of Gulls are often black. Gulls seek their food from the ocean—fishes, crustaceans and molluscs—but many of them are the scavengers of the sea-shore, feeding upon the refuse of the sea as the tide goes down. They will sometimes fly inland seeking for grubs and snails upon some newly-ploughed field. Terns will fly great distances inland, beating the rivers and maritime streams for their prey, and will sometimes hover like hawks over the water. Their breeding places are generally precipitous rocks or stony islands, where they flock together in great numbers; or sometimes inland marshes. There depressions in the rock or soil furnish nesting places; others again will make their nests in trees. The eggs are very varied in colour: olive or green or blue, with blotches or scrawls of black, brown, or purple; sometimes indistinguishable from the stones among which they may be deposited.

Skimmers or *Scissor-bills* are peculiar in having the lower mandible elongated like the lower blade of a tailor's scissors. As they skim along the water they lower this mandible into that element and thus scoop up small fish, crustaceans and the like. They generally choose for their habitat the mouths of rivers where they live in comparative solitude, more than a pair being seldom found together.

The voice of Gulls is generally harsh and discordant, a bark, a grunt or a scream; some species have been named from their note, as for instance, the "Laughing Gull," the "Kittiwake."

The range of Gulls is very wide, the common river tern, for example, being found in the countries on both sides of the Atlantic as also on the Indian and African coasts.

GULLS AND TERNS.—(Colonial.) *Laridae.*

Large-billed Tern		*Phaëthusia magnirostris.*
†Graceful „	(?)	*Sterna elegans.*
*Broad-billed „		„ *eurygnatha.*

Little Tern (eye-browed)	*Sterna superciliaris.*
River "	" *fluviatilis.*
†White-capped Sooty Tern	*Micranous leucocapillus.*
Black-backed Scissor-bill	*Rhyncops melanura.*
†Grey-backed " "	*Larus philadelphia.*
Black-capped Gull	" *atricilla.*
Spotted winged " (?)	" *maculipennis.*

Stercorariidae—

Brown Herring Gull	*Megalestris chilensis.*

PETRELS, SHEARWATERS, ALBATROSSES.

In the Order *Procellariiformes* are included birds of extreme type, as regards size, some *Petrels* being no larger than sparrows, while *Albatrosses* are larger than geese. They are the survival of an ancient form and are distinguished from all other birds by having tubular nostrils. The order numbers some twenty-five genera and includes about ninety-six species. All are ocean birds and notable for their powers of prolonged flight, being often seen several hundreds of miles from the nearest shore. They feed on fish, cesphalopods, and other molluscs. Their cry is varied and has been described as a bay, a croak, a diabolical scream, a puppy's whine, a whistle, etc. They nest on rocks and lay white, lustreless eggs. The Colony can claim, perhaps, but one species—the Stormy Petrel. They are so called because they seem to walk the water, flying low and dangling their legs; a fancied resemblance to St. Peter walking on the sea. They bite severely when taken in the hand.

Albatrosses are white, relieved above by wavy lines, the quill-feathers of the wings being brownish black.

Shearwaters are generally black above and white beneath, and vary in size, most being as large as a pigeon.

Petrels are generally dusky, or sooty black.

ALBATROSSES, ETC.—(Colonial.)	*Procellariidae.*
Stormy Petrel	*Oceanodroma leucorrhoa.*

(*The End.*)

Meeting of The Board of Agriculture.

A MEETING of the Board of Agriculture was held in the offices of the Board, Broad Street, on Tuesday, July 11, His Excellency the Hon. Cecil Clementi, C.M.G. (Officer administering the Government), presiding.

THE PLANT STALLS.

In connection with the returns of plants sold at the stalls belonging to the Board during the period 1st October, 1915 to 31st May, 1916, the Chairman (Prof. J. B. Harrison, C.M.G.), said that at the last meeting he pointed out that the sales had fallen off considerably, and it was a question whether or not it was worth while keeping the stalls open. As there had been no improvement he suggested that the Georgetown stall be abolished. This was agreed to. It was resolved to close down the stall at Morawhanna until after the war, but to keep in being that at Marlborough, Pomeroon, until the lease of the land on which the station is built, expires, and to continue with the stall at New Amsterdam, where a certain amount of business continues to be done. A vote of thanks, proposed by the Chairman, to the Mayor and Town Council of Georgetown for allowing them the use of the stall in the Stabroek Market free of charge, was unanimously passed. Prof. Harrison attributed the poor results from the stalls to the war conditions prevailing, and considered the state of things only temporary.

CENSUS OF AGRICULTURAL INDUSTRIES.

The returns sent in with regard to the agricultural industries of the colony were commented on by the Chairman, who remarked that the cacao figures were always unsatisfactory, the cultivation sometimes being described as cacao, sometimes as coffee and sometimes as rubber. He did not think there had been any actual decrease. Coffee showed a slight falling off; rubber also—due to the throwing out of land planted in *Sapium*—while maize and ground provisions had decreased no less than 1,200 acres. Limes showed a noticeable increase, as did live stock. Thus there were 74

more donkeys, 7,000 more cattle, 8,000 more sheep, 160 more goats, and 2,800 more swine. Last year there was a marked decrease in this last item, owing to the prevalence of swine fever. Buffaloes showed an increase of 37.

PEST POSTERS.

It was announced that of the posters describing colony fungus pests and remedies, 52 had been distributed and 52 sold; of the insect pests poster, 53 had been distribted and 55 sold. The demand seemed to be greater outside than in the colony.

CANE FARMING.

Commenting on a Minute by the acting Governor of Trinidad, dealing with the regulation of prices in the cane farming industry, Mr. Shankland pointed out that conditions and methods of computation differed in this colony so widely from those obtaining in Trinidad, that a comparison was hardly feasible.

The President intimated that he proposed to appoint Messrs. C. Morris and H. E. Murray to the Board *vice* Colonel de Rinzy and Mr. J. Brumell (deceased). The appointment of Mr. Pudsey (Acting Director of Public Works) in place of the Hon. E. C. Buck (resigned) was announced.

The Chairman announced that there had been another severe outbreak of the caterpillar pest (*Brassolis sophorae*) of coconuts on the East Coast. Steps were being taken to deal with the trouble.

Specimens of logwood (*Haematoxylon*), such as were to be found growing at certain places on the East Coast, were exhibited, and the Chairman referred to the enhanced value of the wood in the present scarcity of dyes.

The formation of a "Government Farms Committee" of the Board was announced, as was the completion of arrangements with the Imperial Department of Agriculture for the sale of some of their publications under the auspices of the Board.

SATISFACTORY PRICES OF RUBBER.

Referring to the sale of rubber prepared by the Department of Science and Agriculture in 1915 and 1916, Prof. Harrison stated that results had been exceedingly satisfactory, the product, with one exception, fetching the highest price in the market.

It having been pointed out by Mr. Withers, Manager of the Hills Estate, Bartica and of Agatash, that in the export returns of the colony there was no record of the export of concentrated lime juice or of essential oil of limes, Prof. Harrison suggested that steps should be taken to have these details included in the returns. This was agreed to.

THE AFFILATION OF FARMERS' ASSOCIATIONS.

The affiliation of the West Bank Farmers' Association was announced, and some discussion arose over the applications for a similar privilege of the Buxton and Friendship Farmers' Association and of the Victoria-Belfield Agricultural Association which did not satisfy the conditions laid down by the Board with regard to the status of their financial members. It was decided to suspend the granting of affiliation to these bodies until they had satisfied the Board in this matter.

AFFAIRS IN THE CANAL POLDER.

Mr. Earle pointed out that circumstances would prevent the West Bank Farmers' Association from holding a Show this year, and Prof. Harrison suggested that the money which would have been given in prizes might be devoted to a scheme for rewarding those proprietors in the Polder who showed the greatest improvement in their drainage. His officers had recently visited the Polder and had reported that the drains were in many cases far from satisfactory. Prizes of $50, $30, $20, and two of $10 might be offered, and a Committee of the Board might adjudicate in the matter next December.

His Excellency thought it was a good opportunity to put clearly the position of the Government. He had him-

self visited the Polder and had noticed that not only were the small drains in bad condition, but the "B line" trench was overgrown with weeds for a great part of its length and needed cleaning badly. That was a matter for the Polder. The only reason why a Government officer was associated with the Polder Authority as chairman was because the Polder owed the Government money and it was necessary for the Government to have control of the finances of the Authority. That was secured by appointing a chairman and auditor, but the executive control of the area, the cleaning of the canals and so on were the duty of the Authority, and it was for the people who lived in the Polder and were the beneficiaries of the scheme—which was a good one and drained some of the best land in the colony—to see that this duty was carried out.

Mr. Earle pointed out that he had lost $1,800 and others more than that.

After some discussion, the Chairman's suggestion was adopted, and Messrs. Junor, Earle, and Shankland were appointed on a Committee to suggest details.

In connection with the recrudescence of anthrax on the East Coast, the Chairman mentioned the interesting fact that his Department has discovered that the infection was confined to certain fields on certain estates. The quarantine orders would therefore be modified and relate to these restricted areas only. Swine fever was now practically eradicated.

Specimens of bauxite and of iron ore from the North West District were exhibited.

The Board then adjourned *sine die.*

The Farmer and Experiments.

Science and practice helped by experience—that is what we want. Experience means that which we have ourselves learnt; that which has been knocked into us forcibly is never forgotten. This is why it is so often advocated that "every farmer should be his own experimenter."

—"The Journal of the Department of Agriculture," Victoria, (Australia.)

Hints, Scientific and Practical.

The Agricultural School, Ceylon.

THE Director of Agriculture is the Principal, and Mr. Drieberg, Superintendent of Low-Country Products, the Vice-Principal, whilst the staff of the Department of Agriculture will constitute the lecturing and demonstration staff on the School.

Those who know Ceylon will be interested to hear that the School is situated close to Peradeniya Gardens, on the main road from Colombo to Kandy, ten minutes from the new Peradeniya station. Peradeniya Gardens are nearly a hundred years old, and as they cover an area of 150 acres and contain almost every economic product of importance. The student surely can wish for nothing better as a centre of education, both in the open as well as indoors, as the library has 6,000 volumes, and the herbarium 22,000 floral specimens, whilst other sections have over 10,000 specimens of economic importance.

Such a spot must also be ideal for English students, for Peradeniya is situated some 1,600 or 1,700 ft. up, and enjoys a mean temperature of 75° F. The nights are said to be always cool, and even in the hottest months the days are not too oppressive for study. Candidates for admission must be at least 17 years of age, and have attained a certain standard of education. The fees, payable in advance, are Rs 30 per month for board and tuition, or Rs. 7.50 for tuition only. At present only a limited number of boarders can be accommodated. Work begins with the school muster at 6.20 a.m., and lights must be out by 10 p.m. Breakfast is at 11 a.m. and dinner at 7 p.m. There is no regular work for Saturdays but independent investigations and expeditions are expected to be carried out. The course of instruction includes the soil, manures and manuring, plant chemistry, crops (a wide range, *i.e.,* over seventy in all), pests, diseases, agricultural engineering, stock-raising, co-operation. Demonstrations will be given of how to plant, prune, graft, transplant, fell trees, and many other most necessary things, whilst under the head of plant-

ing everything necessary to learn in connection with each of the leading crops will be included; amongst them we note demonstrations in dynamiting for planting, for subsoiling, blasting rocks and stumps, etc.

—"The Tropical Agriculturist," (Ceylon), February, 1916.

Purifying Water for Stock.

A SIMPLE method for purifying almost any water for drinking without boiling it, has been worked out by Dr. G. G. Naismith, director of the Health Laboratories of Toronto, Canada, and Dr. R. R. Graham, assistant chemist. The process is as follows:—Add a teaspoonful (not heaped up) of chloride of lime, containing about one-third available chlorine, to a cupful of water. Dissolve, and add in any convenient receptacle three more cupsful of water. Stir and allow to stand for a few seconds in order to let the particles settle. This stock solution, if kept in a tightly stoppered bottle, may be used for five days. Add a teaspoonful to 2 gallons of water to be purified; stir thoroughly in order that the weak chlorine solution will come into contact with all the bacteria, and allow to stand for ten minutes This will effectually destroy all typhoid and colon bacilli, or other dysentery producing bacilli in the water. The water will be without taste or odour, and the trace of free chlorine added rapidly disappears.

Water containing mud in suspension is easily clarified by dropping hot wood ashes into it, or by the application of lime or alum. These two substances make the water hard. Chloride of iron may also be used. It is quite harmless and a valuable constituent for all animals. Medical men prescribe iron in one of its several forms as a tonic. One pound of chloride of iron (2d. per lb.) will clarify 1,000 to 2,500 gallons of muddy water, and much reduce the bacterial contents.

—"The Journal of the Department of Agriculture," Victoria, (Australia.)

The Measurement of Osmotic Pressure by Direct Experiment

As long ago as 1748 it was discovered by Nollet that a flow of water took place through a membrane of pig's-bladder separating alcohol from water. This observation was forgotten during more than half a century, until it was redescribed in 1802 by Parrot, who also detected a similar flow when urine was used instead of alcohol. Parrot recognised that a flow of liquid took place simultaneously in both directions but that the velocities differed so widely that a pressure might be developed, on one side of the membrane, equivalent in some cases to a column of water not less than 10 feet in height. Quantitative measurements made by Dutrochet (1827), to whom we owe the terms exosmose and endosmose and by Vierordt (1848) showed that the rate of flow depended on the nature of the membrane, on the concentration of the solution and on the temperature; but the factors determining the flow were too complex to allow of any simple statements of the laws governing osmosis. One of the first generalisations to be attempted was suggested by Jolly in 1848, when he brought forward evidence to show that a fixed ratio existed between the exosmosis or outward flow of the salt through the membrane and the endosmosis or inward flow of water into the solution. This ratio, the "endosmotic equivalent," he supposed to be independent of the concentration but further investigation showed that this was not the case.

Equally little progress was made when experiments were carried out to determine the maximum "head" of liquid which could be driven up by the osmotic flow of water into a solution. It is true that one factor, the frictional resistance of the membrane to the endosmotic flow, was now eliminated; but so long as an exosmotic flow still took place the "head" of liquid or "osmotic pressure" was still dependent on the individual properties of the particular membrane used. No real progress could be made until this difficulty was overcome by the discovery of "semi-permeable" membranes which would stop completely the outward flow of the solute whilst still permitting the solvent to pass inwards to the solution and there develop the maximum osmotic pressure that was possible Such membranes were, in fact, discovered by Traube in 1865 in the form of floating films precipitated by the interaction of two contiguous

solutions. Traube then showed that if solutions of copper sulphate and potassium ferrocyanide are brought together, a floating membrane of copper ferrocyanide is produced which is permeable by water but impermeable by both salts. According to the relative strengths of the two solutons, water is drawn in one direction or the other through the membrane which is so displaced that it always forms the boundary between the two solutions. If the boundary expand or if the membrane be broken, a fresh precipitate is at once produced by the interaction of the two membrane-forming solutions.

But whilst Traube's membranes possessed the property of being semi-permeable, they were not suitable for quantitative experiments, as they were incapable of supporting even the smallest osmotic pressure. Great importance attaches therefore to the introduction by Pfeffer in 1876 of methods by which Traube's membranes could be strengthened by precipitating them on linen or silk or parchment or best of all in the pores of an unglazed porcelain battery-jar. With this equipment, it was possible, for the first time, to make real measurements of the maximum osmotic pressure set up in a solution by the inflow of water through a semi-permeable membrane. Even then, however, very few regularities were discovered: the maximum pressure was found to be proportional to the concentration of the solution but no indication was obtained of any law by which the magnitude of the pressure could be predicted.

In view of the obscurity in which the phenomena of osmosis were involved, it would be difficult to exaggerate the dramatic effect produced by the discovery, made by Van't Hoff in 1887, that the gas-equation PV=RT could be applied directly to solutions, if "osmotic pressure" were substituted for "gas pressure." This remarkable generalisation appeared to illuminate a vast range of difficult and puzzling phenomena and at the time of its introduction it was widely believed that the problems of osmotic pressure and of solutions had for the most part been finally solved.

—"Science Progress," April, 1913.

The Manure Heap and the House-Fly.

As already fully recognised, the house-fly is liable to breed in large numbers in stable refuse which is stored in close proximity to dwellings. The governing factor is found in the dwellings rather than in the manure heap, the latter merely serving as a secondary convenience, providing a breeding place for the flies which have been attracted to the house in search of food.

The open farm manure heap far away from houses is but little frequented by house-flies, and then only later in the season when the insect has become numerous and widely dispersed.

The spent manure heap, in which fermentation has practically ceased, produces under rural conditions, at least, practically no flies at all.

Although the farm heap may produce but few house-flies, it is a prolific source of *Stomoxys calcitrans*, and those agriculturists who value the comfort and health of their animals should treat all manure with a view to the destruction of the larvae of this pest.

It should be clearly understood that the above conclusions apply to manure heaps far distant from houses. Where the farm dwelling and the farm buildings adjoin, as they do in so many cases, the danger of the manure heap becomes much greater, particularly where dairies or other food-preparing departments are in proximity to farm refuse.

For the town manure heap no regulations can be too drastic, and it is but little creditable to our local authorities, and even less so to to the proprietors, that bad conditions should be permitted to exist.

Mention has been made of *Stomoxys calcitrans* as a pest to cattle. The "biting house-fly," as it has been called, is a blood-sucking insect possessing great capabilities as a carrier of disease, and it is by no means inclined to distinguish for alimentary purposes between the human and the equine species.

—Dr. H. Eltringham in "The Journal of Agricultural Science," April, 1916.

Air and the Roots of Plants.

A CLEAR presentation of the relations between the air supply in the soil and root development is not often to be found in the literature. A great deal of emphasis is laid on the functions of the roots and on the part played by the root-hairs in absorbing water and food materials. The needs of the active cells of the root itself are generally ignored. There is, however, one well marked exception. In Sorauer's "Popular Treatise on the Physiology of Plants," occurs an excellent account of the needs of the root, in relation to practice, in which great stress is laid on the necessity of constant aeration, and of continuous gaseous interchange between the atmosphere and the soil. During growth, the oxygen in the soil is not only drawn upon by the protophlasm of the root-hairs and of the other active cells of the root, but, at the same time, the proportion of carbon dioxide is greatly increased. This gas is given out by the growing cells and is also produced by the decay of organic matter. Many of the soil bacteria also need free oxygen and besides increase the amount of carbon dioxide. Unless copious ventilation takes place, the supply of oxygen will be exhausted and, at the same time, the soil air and water may become charged with carbon dioxide to such an extent that a poisonous atmosphere for the roots is produced. Growth will stop for two reasons. In the first place, there will be no air for the working cells of the root and they will die of asphyxiation. In the second place, there will be direct inhibition due to the presence of large quantities of carbon dioxide which Sorauer states is a poison for roots.

In the case of leguminous plants, an adequate supply of air for the root is even more important than in other crops. As is well known, these plants are provided with special root factories (nodules) in which, by means of bacteria, atmospheric nitrogen is worked up into complex nitrogenous substances which the plants can use as food. Both oxygen and nitrogen are essential raw materials for these factories and must, therefore, be provided if these plants are to thrive. This can only be done by efficient soil ventilation and by the provision of ample means of gaseous interchange between the soil and the air.

—A. and G. L. C. Howard in Bulletin No. 52 of the Agricultural Research Institute, Pusa (India).

The Genus "Diplodia."

It has long been known that those members of the *Sphaeropsideae* which produce brown uniseptate spores are extremely variable. The distinctions between the genera *Diplodia*, *Botryodiplodia*, *Chortodiplodia*, *Lasiodiplodia*, and *Diplodiella* have been based on slight structural variations in the pycnidia. The points of separation are the or caespitose; their relation to the host, whether subcutane- or cespitose; their relation to the host, whether subcutaneous, erumpent or superficial; the presence or absence of bristles and of paraphyses. These are all characteristics which one might expect to vary somewhat with the characteristics or condition of the host. This variation probably occurs; and for this reason there has been some uncertainty as to the proper position certain species should occupy in classification. *Botryodiplodia theobromae* Pat., which causes a die-back of *Hevea braziliensis* in Ceylon, southern India, and the Malay States, is an example; and in his account of this fungus Petch remarks that "Among the names which are known to refer to this species are *Macrophoma vestita*, *Diplodia cacoidola*, *Lasiodiplodia theobromae*, *Diplodia rapax*, and there are probably others. *Botryodiplodia theobromae* is its earliest name, as far as is known, but some prefer to call it *Lasiodiplodia theobromae*."

Taubenhaus as a result of his inoculations upon sweet potato (*Ipomoea batatas*) *with Diplodia tubericola* (E. and E.), *Diplodia gossypii* (Zim.), *Diplodia natalensis*, (Pole Evans) and *Lasiodiplodia theobromae* (Pat Griff. and Maubl.), suggests that the characteristics of the genus *Diplodia* be so extended that it may include all of the five genera

This genus, although it is not thought to include forms which are absolute parasites, is nevertheless a source of serious trouble among some of our cultivated plants. The injury is usually confined to a fruit-rot or to a dieback of the younger branches or shoots as in the citrus disease prevalent in Florida and the Isle of Pines. In both cases the fungus has been described as following an injury which has been previously inflicted either by mechanical means or as the result of the action of some other fungus. In the United States the more important crops which hitherto have

been known to be affected are sweet potato, citrus fruits, corn (*Zea Mays*), and cotton (*Gossypium* spp.) In our Southern States the *Diplodia* injury is of considerable consequence in connection with these products. As one enters the Tropics the number of plants which are attacked increases. Among the list of hosts found here are *Citrus* spp., *Herca* spp., *Theobroma Cacao*, and *Thea* spp. In certain cases where the growing plant is attacked, the injury produced is sufficient to cause the death of the host, as is the case with *Diplodia vasinfecta*, (Petch), which causes an internal root-rot of tea.

—F. C. Meier in "Journal of Agricultural Research," (U.S.A.), April 24, 1916.

Gunfire and Rainfall.

An impression has arisen in some quarters that the heavy and persistent rains recently experienced in this country [Great Britain] are attributable to abnormal atmospheric disturbances produced by heavy gun firing at the seat of war. The idea is by no means novel, and like other meteorological myths (such, for instance, as the belief in thunderbolts and the supposed influence of the moon upon our weather) it seems to possess a bullet-proof hide and takes any amount of killing. About four years ago the First Lord of the Admiralty was asked in the House of Commons whether he would instruct the fleet to carry out their heavy gun practice at some period of the year other than in the middle of harvest time, 'when the resultant heavy rain may cause serious loss to the farming community.' A similar suggestion was made at the instance of a member of the Highland and Agricultural Society of Scotland who at a meeting of that body, moved that 'the Admiralty be petitioned to discontinue heavy gun-fire round the coasts in August and September, 'when clouds were about' (*sic*), the speaker adding that 'firing was apt to bring down rain, and at that time of the year fine weather was desirable.' It may be said at once that the idea is absolutely without foundation. Experiments made some years ago in America and on the Continent showed that in droughty weather no amount of concussion in the air artificially produced had the slightest effect in the production of rain.

—"The Times," (London.)

The District Gardens.

Record of Attendances.

Under the name of "District Gardens," some of the Model Gardens, founded in 1908, and abolished by resolution of the Combined Court in March, 1915, have now been reconstituted. Below will be found the details of the attendances at these gardens from January to the end of June this year. It will probably be a considerable time before the numbers approach those recorded before the abolition of the Model Gardens, for the increasing interest and confidence of parents, teachers and children received a rude shock—and these things are plants of slow growth.

Quarters.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Demerara.	Suddie, Essequebo.	Dem Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1914.										
First ...	1,134	481	1,245	624	564	1,014	475	498	370	6,405
Second ..	1,047	489	1,008	699	322	726	428	425	263	5,407
Third ..	1,087	481	844	667	451	728	368	369	511	5,506
Fourth ..	975	535	772	453	536	557	520	351	389	5,098
1915 :—										
First ...	1,123	641	1,006	769	1090	59	503	339	401	5,931
Second ...	—	—	—	—	—	—	—	—	—	—
Third ...	—	—	—	—	—	—	—	—	—	—
Fourth ...	—	—	—	—	—	—	—	—	—	—
1916 —										
First ...	910	—	—	35	—	—	—	169	—	1,309
Second ...	1,241	—	207	707	—	—	110	723	241	3,229

Census Returns of Agricultural Industries.

Below will be found the figures giving the state of the Agricultural Industries of the Colony for 1915.

Acres.	*1915.*	*1914.*	*1915.* *Increase.*	*Decrease.*
Canes	75,744	73,108	2,636	...
Rice	50,737	47,037	3,700	...
Coconuts	17,920	15,894	2,026	...
Cacao	2,020	2,454	...	434
Coffee	4,468	4,326	142	...
Rubber	4,687	4,962	...	275
Limes	973	690	383	...
Maize and Ground Provisions	19,820	21,063	...	1,243
Head.				
Horses	1,006	1,013	...	7
Donkeys	6,078	6,004	74	...
Cattle	97,768	89,297	8,471	...
Sheep	22,150	19,734	2,416	
Goats	15,290	14,831	459	...
Swine	13,768	10,926	2,842	...
Mules	2,137	1,998	139	...
Buffaloes	136	99	37	...

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported up to the end of June, 1916. The corresponding figures for the two previous years, and the averages for the four years previous to that, are added for convenience of comparison.

Product.	*Average 1910-13.*	*1914.*	*1915.*	*1916.*
Sugar, tons ...	26,107	32,576	42,440	37,493
Rum, gallons ...	1,050,140	1,646,370	2,030,872	2,496,763
Molasses, casks ...	591	659	...	...
Molascuit, tons ...	3,235	1,050	979	522
Cacao, cwts. ...	132	299	284	29
Citrate of Lime, cwts.	..	21	71	304
Lime Juice, conc., gals.	...	...	...	3,057
Essential oil of Limes, gals.	...	...	...	198
Coconuts, thousands	566	1,091	1,064	894
Copra, cwts. ...	605	820	843	1,206
Coffee, cwts. ...	840	1,756	679	2,342
Kola-nuts, cwts. ...	2	...	2	...
Rice, tons ...	2,593	3,967	5,653	8,590
Ricemeal, tons ...	874	202	205	85
Cattle, head ..	473	623	307	273
Hides, No. ..	2,376	2,738	864	2,551
Pigs, No. ...	645	653	540	479
Sheep, head ...	37	12	4	22
Balata, cwts. ...	1,582	3,128	7,568	4,195
Charcoal, bags ...	36,081	36,861	28,236	27,431
Firewood, Wallaba, etc., tons ...	5,175	5,652	4,442	6,098
Gums, lbs. ...	1,804	719	...	883
Lumber, feet ...	185,368	198,145	31,619	211,015
Railway sleepers, No.	1,975	2,602	556	1,825
Rubber, cwts ...	6·5	6	17	55
Shingles, thousands	1,136	1,061	1,070	1,011
Timber, cub. ft. ...	173,927	182,468	85,807	71,231

Selected Contents of Periodicals.

Some Experiments on the House-fly in Relation to the Farm Manure Heap.

Cause and Prevention of Rancidity in Palm Nut Kernel Cake.

The Fungicidal Properties of Certain Spray-fluids.

"The Journal of Agricultural Science,"
April, 1916.

Soil Ventilation.

Bulletin No. 52: Agricultural Research Institute,
Pusa, (India).

Tobacco.

Great Students of Plant Life.

"The Tropical Agriculturist," (Ceylon.)
March, 1916.

Bemesting van Rijstvelden.

"West Indië Landbouwkundig Tijdschrift,"
(Surinam), April and June, 1916.

The Mathematical Theory of Organic Variability.

"Science Progress" April 1916.

Water-melon Stem-end Rot.

Crown-gall Studies.

"Journal of Agricultural Research,"
(U.S.A.), 1916.